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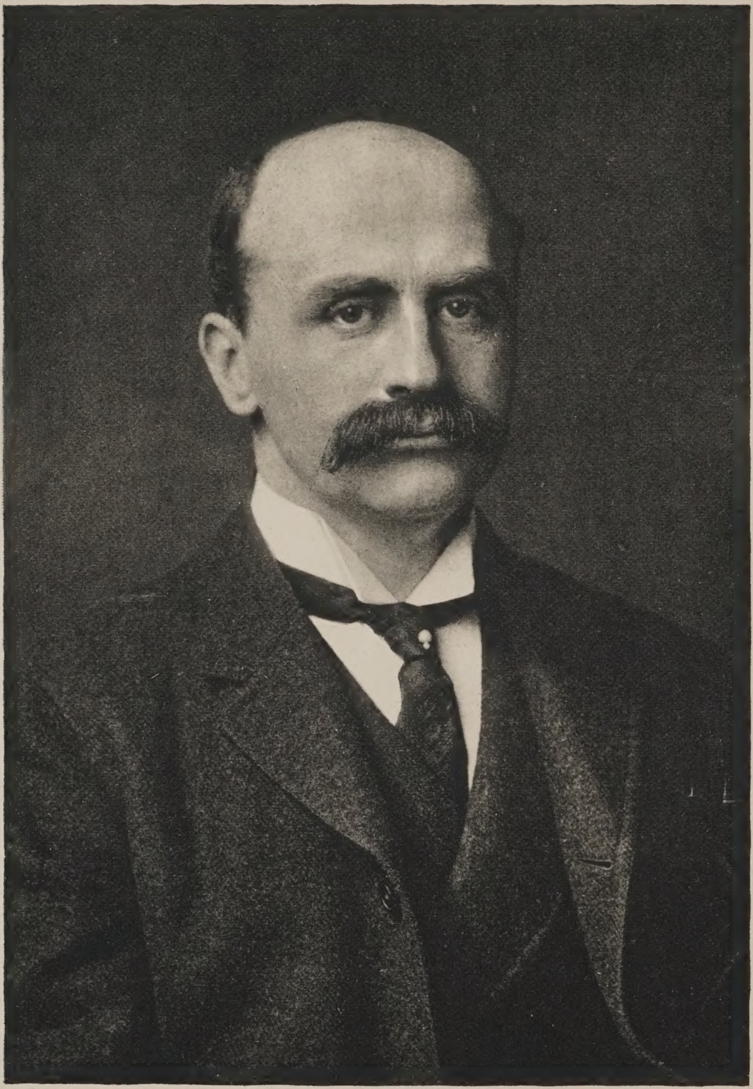

JAMES WRIGHT MARKOE, M.D.

1862–1920

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Bulletin of the Lying-in Hospital of the City of New York

Vol. XII JULY, 1922 No. 2

In Memoriam

JAMES WRIGHT MARKOE, M. D.
1862-1920

Shortly after the publication and distribution of the last previous issue of this BULLETIN, the life of Dr. James W. Markoe was taken by an assassin's bullet. As the present number is the first to be published since his untimely death, a formal recognition of the event in its pages has therefore been unavoidably postponed.

Dr. James Wright Markoe was born in New York City on July 19, 1862, one of a family of medical men. His father, Dr. Thomas Masters Markoe was a noted physician in this city a half century ago and long a member of the attending staff of the New York Hospital. An older brother, Dr. Francis H. Markoe, was Clinical Professor of Surgery at the College of Physicians and Surgeons and prominently identified with the St. Luke's, New York and Bellevue Hospitals.

Educated in private schools and at St. Paul's in Concord, New Hampshire, Dr. Markoe was graduated in medicine at the College of Physicians and Surgeons with the class of 1885.

He served as an interne at the New York and the Nursery and Child's Hospitals and then went abroad for a term of study, chiefly with Prof. v. Winkel, of Munich. After his return to this country he entered the Sloane Maternity Hospital and served as its first resident physician.

Subsequently, in 1890, he was one of a group of physicians which organized the "Midwifery Dispensary" in Broome Street.

This institution was aided during 1891 and 1892 by contributions from the Society of the Lying In Hospital and the two institutions were merged in 1892, the name of the "Midwifery Dispensary", more popularly designated as "Broome Street," being abandoned and the combined institutions being thereafter known as the Lying-In Hospital. The patients at that time were all confined in their homes by medical students under the guidance and personal supervision of the attending physicians. The purpose of this was to develop a system of practical instruction in obstetrics, which had been previously lacking in the curriculum of most American medical schools. At the same time the service afforded skilled attendance to many women of the poorer classes who had to depend on ignorant midwives or poorly equipped physicians for attention during this important period of their lives. The continued and rapid growth of the work demonstrated the need for a suitable building, which would not only serve as a center of instruction for students and nurses, but would likewise accommodate a certain number of patients who could not be taken care of at home. The Board of Governors of the Society of the Lying-In Hospital then authorized in 1894 the purchase of the Hamilton Fish residence at Second Avenue and 17th Street, which, remodelled and converted into a hospital, served its purpose until the constantly expanding demands of the service resulted in the plans which culminated in the present magnificent building erected through the munificence of a Governor of the Society,—Mr. J. Pierpont Morgan. The new hospital was opened for the reception of patients in January, 1902, and marked the culmination of the efforts towards the upbuilding of what is believed to be one of the largest obstetrical services in the world. Associated most prominently with Dr. Markoe during this period were Drs. Samuel Lambert, H. McM. Painter, J. Clifton Edgar, Austin Flint, Jr., and Asa B. Davis, the present Chief Surgeon of the Hospital.

The most active period of Dr. Markoe's life was closely connected with the development of the Lying-In Hospital and its various activities. He served as attending physician, medical director, and chief surgeon, from 1890 until 1918, a period marked by constant and faithful attendance to the work of the institution.

The establishment of this BULLETIN was largely due to the efforts of Dr. Markoe, who was desirous of recording the scientific work of the hospital in a collected and durable form; he was also among its most faithful and constant contributors. Perhaps his most noteworthy contribution is a statistical study of 60,000 confinements from the service of the hospital, presented at the International Medical Congress in Budapest in 1909. This important study was based on the records and histories of

20 years and has been extensively quoted in medical literature as one of the most comprehensive series of observations of the kind in any single institution.

Dr. Markoe retired from active association with the Lying-In Hospital in 1918 to devote himself to his private practice and to gain a well earned rest. His indomitable energy, his devotion to the service, his desire to make the hospital the leader in its field, and his ability as a teacher, will all serve to accord him a prominent place in the development of this institution and of obstetric teaching. His untimely death, while still in the prime of life, was a shock to his many friends and associates.

A member of numerous clubs and medical societies, Dr. Markoe was for more than twenty years a communicant and vestryman of St. George's Church. In its edifice he was married and subsequently led his only daughter to the altar of matrimony. It was here likewise, while engaged in his customary duties during the Sunday morning service of April the eighteenth, 1920, that the madman's missile found its mark, and it was to the Hospital, with which he was so closely identified, that he was immediately brought, unfortunately too late for mortal aid.

THE MANAGEMENT OF TEETH DURING PREGNANCY.[1]

BY

WALTER N. ROWLEY, M. D.
Associate in Section on Obstetrics,
Mayo Clinic, Rochester, Minnesota.

MENTION of toothache and dental caries during pregnancy is found in all textbooks and in most articles on prenatal care. The statements that these patients should be referred to a competent dentist, and "proper dental care instituted," is often seen, but there is little further in the way of comment or instruction.

Ballantyne, in a study of 100 cases in the Edinburgh Royal Maternity Hospital Antenatal Clinic, noted that 98 per cent. of pregnant patients had dental caries or infection, and 93 per cent. had submitted to one or more extractions. Fifty-three per cent. of the patients were less than twenty-five years of age and only two of these had undecayed teeth. The histories of these patients showed that the most common dental procedure was wholesale extraction and the use of plates; 48 per cent. of the 100 patients wore one or more plates. In a few instances a history of dental manipulation during pregnancy was elicited, but generally there was a prejudice against such interference during the expectant period and carious teeth were left strictly alone. Ballantyne believes that carious and infected teeth cannot fail to react on the mother's condition and retard the return to complete health in the puerperium. He argues that if surgical operations can be safely carried out during pregnancy, dental work can be done at this time. Goodman advises the early care of dental conditions in these patients and mentions the fact that dentists still fear the danger of abortion resulting from dental manipulation. He quotes Waller's experience which led him to believe that if the removal of dental foci is adequately carried out, even after it has produced symptoms, improvement in the mother's health is sufficiently rapid and substantial to be of signal benefit to the child. Roentgen-ray examination is a necessary preliminary to the removal of the infected teeth.

La Vake mentions infected teeth and tonsils as a possible cause of nephritis in pregnancy, of preclamptic toxemia, and of eclampsia; he reviews thirteen cases in which infection was a prominent feature. All his patients either had preeclamptic toxemia or eclampsia, and all gave histories of endocarditis, rheumatism, toothache and oral or tonsillar infection. Fever was present in all cases before convulsions occurred or before manipulation. Six of the patients were multiparas whose labors had previously been normal and who had a history of infections since the first pregnancy.

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[1] Presented by invitation, at a meeting of the Lying-In Hospital Alumni Association, November 15, 1921.

La Vake believes that every pregnant patient should be given a thorough dental examination with immediate eradication of foci of infection. He has never observed a case of abortion which could be attributed to dental manipulation. De Lee states that during pregnancy the teeth decay more easily than otherwise, due to alteration of the secretions of the mouth, perhaps because of the demand of the foetus for more calcium salts, or because the teeth partake of the general changes exhibited by the osseous system. He also considers it possible that certain obscure puerperal infections have their origin in abscessed teeth. The authors of most texts on obstetrics mention the superstition of the laity and the mistaken idea current among members of the dental profession with regard to the dangers that might result from dental extraction; no particular information is given further than that extractions may be done under gas and that extensive fillings should not be attempted.

Because the burden of conducting a woman through pregnancy to ultimate good health with the added comfort of a healthy child falls to the obstetrician, more and more cooperation is necessary in order that the best advice and care, may be given to the mother. Focal infection with its possible effect has been a subject discussed with lively interest by the medical and dental professions for the past few years, and the teeth have been recognized as a vital factor.

Full mouth roentgenograms are made in the Mayo Clinic of every pregnant patient presenting any signs of dental or oral disease. Furthermore, a careful interpretation of these findings is made with the basic condition primarily in mind, and treatment is advised with a view to preserving the maximum usefulness of the remaining teeth, should extraction be carried out. Whenever a diagnosis of periapical infection is made, extraction is usually advised. If caries is advanced to such a degree that devitalization is necessary for proper restorative dentistry, extraction is preferred, since tiring dental manipulation is believed to be detrimental to the health of the patient and experience has shown that many devitalized teeth develop periapical infection. During pregnancy temporary cement fillings for cavities in vital teeth are preferred to more permanent inlays. Cultures from roots of devitalized teeth extracted in the dental section of the Mayo Clinic have consistently shown a positive growth of streptococci of either the viridans or hemolytic type. Pyorrhea should be treated by conservative measures and prophylaxis instituted when indicated.

In determining which of several periapically infected teeth should be extracted the general condition of the patient is considered, signs of trouble attributable to focal infection are sought, and other sources eliminated as far as possible. Extraction may be advised in the presence of periapical infection, even though symptoms attributable to foci of infection are wanting. Teeth with frank involvement of the surrounding bony structure are selected first. Examination of the urine is always made at each antenatal visit and if the patient is sent for the extraction of one or more selected teeth, later urinalyses are made. The local, as well as the general reaction is carefully noted and taken into consideration before further extractions. Practically no general reaction is noted, even in cases of marked osseous involvement. In cases in which a slight general reaction is anticipated, temperature readings are made, but a rise is not often noted. When a slight general reaction is manifested following the first extraction more time is allowed between operations. The patients rarely show reaction after the second extraction, possibly as a result of immunization following the first extraction. Leukocyte counts are made in some instances; a group of cases is now being studied in which differential blood counts are made before and after extraction. A slight rise in the leukocyte count has been noted in a few cases. Most of the extractions are done by a surgical technic, as described by Novitsky, Shearer and Gardner. The granuloma is removed intact; the amount of trauma is minimized; and absorption is reduced. This accounts at least in part for the absence of general infection.

A small group of thirty patients, reviewed preliminary to further work on dental management, shows a diversified type of case, represents nearly all periods of pregnancy, and includes instances of single extractions as well as extensive removal of infection from the mouth. In not a few cases there are complications to pregnancy, and removal of dental foci was only part of the general treatment. Twenty-two of the patients were more than twenty-five years of age, fifteen were in their first pregnancy, eight in their second, three in their third, two in their fourth and two in their fifth. One of these had had nine gestations and only one full term child.

The number of teeth extracted varies from eight cases with one extraction each, to one case with fifteen extractions.

The period of gestation during which the extraction was done varied with the time the patient first presented herself for examination and with her condition. Eleven had extractions in the first trimester; this includes patients suffering with nausea and vomiting. Many patients did not present themselves for examination until the seventh month of pregnancy and at this time seven patients had extractions. Six patients were examined soon after they felt quickening. Eight patients had extractions between the fourth and fifth month, two in the sixth month, and two in the ninth month. Twenty were delivered at term; four are still pregnant and under observation; two aborted; four went into labor prematurely, one spontaneously and in the others labor being induced because of complications.

In the two cases of abortion the miscarriages were not dependent on the dental manipulation.

Case 1 (A233969). Mrs. F. primipara, aged twenty-four years, came for examination because of nausea and vomiting at the seventh week. The uterus was anteflexed. One tooth extracted by her husband, a dentist. In seven days nausea and vomiting subsided so that she was comfortable throughout the day. Six weeks later, about twelve hours after driving several hours over frozen roads pain and bleeding commenced; abortion occurred two days later.

Case 2 (A360904). Mrs. S., primipara, aged eighteen years, suffered from marked nausea and vomiting. The uterus was acutely anteflexed. Three abscessed teeth were removed in the second month of pregnancy. Seven days later the patient left the hospital relieved of the nausea and vomiting. At four and one half months abortion occurred at home. Her family physician attended her and no cause was given; but it is likely the anteflexion and farm work which she did were the most probable causes.

Labor was induced prematurely in four cases; in three of these because of marked albuminuria with evidence of renal damage in the eighth month. The babies and mothers survived without incident. In one case labor was induced at the sixth month for severe neuroretinitis. Another patient had a normal full term pregnancy and then had seven abortions in the third or fourth months. During the ninth pregnancy her general condition improved very much after tonsillectomy and the extraction of seven teeth. The blood pressure dropped from 170 systolic to 130 systolic and from 126 diastolic to 90 diastolic. Pregnancy carried to seven months or a little over. An acute "cold" of moderate severity was followed by a sudden rise of blood pressure from 130 systolic to 180 systolic. Foetal movements stopped. Labor was induced and the patient delivered a still born child with multiple recent hemorrhages of the skin, liver, brain and lungs. The fourth patient left the clinic and was not heard from until two months later when labor started prematurely in the seventh month, nearly three months after her extraction had been done. Other complications seemingly benefited by extraction were nausea and vomiting, local pain and debility.

The most interesting case from the standpoint of benefit from extraction of abscessed teeth is that of a woman who presented herself for examination at the seventh month of pregnancy because of dyspnea, exhaustion and rheumatic pains in nearly every joint. General examination led to the diagnosis of mitral endocarditis with insufficiency, aortic endocarditis with insufficiency chronic rheumatic arthritis, and marked dental and oral sepsis. The upper left gum was markedly swollen; purulent material could be expressed from many points; and most of the teeth were carious and destroyed to the gum margin. The blood pressure was 140 systolic and 75 diastolic; the pulse rate 120 per minute. The urine showed a trace of albumin. The temperature was normal and a blood culture was negative after forty-eight hours on a blood agar slant. The left side of the upper jaw was cleaned up at the first operation and no change of the urine, temperature and blood culture followed. The remaining teeth and roots were later removed, sixteen in all. Improvement was marked in ten days, and she returned for delivery one month later, when examination revealed the blood pressure to be 122 systolic, 76 diastolic, and the pulse rate 84 per minute. There was no dyspnea, except on exertion; the pulse was more regular, the heart was reduced in size, and compensation was restored. Two months postpartum the tonsils were removed and dental work was completed for full plates.

The study of this group of cases has led me to believe that the removal of teeth with periapical infection and extensive caries can be safely done during pregnancy. Surgical removal in such cases is preferable in the presence of definite roentgenological evidence of granuloma. Careful roentgen ray examination, interpretation and cooperation with the dentist are highly essential. Surgical extractions in these cases should be done according to a definite plan, with a careful consideration of the number of teeth to be removed at one operation, the condition of the patient and her reaction following the first extraction. Repeated examination of the urine, temperature, and leukocytes should be made, and general symptoms of reaction manifested by the patient should be carefully observed. Pyorrhea should not be overlooked and cavities in vital teeth should be filled with cement rather than more permanent materials. In the presence of pathological conditions associated with pregnancy the same precuations must be taken as are observed in similar conditions existing independently of pregnancy. The eradication of foci of infection other than the teeth is equally important in the hygiene of pregnancy.

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CERTAIN POINTS IN THE MANAGEMENT OF THE SECOND STAGE OF LABOR[1]

BY

ROSS McPHERSON, M. D., F. A. C. S.,
Attending Surgeon

IN CHOOSING this title for your consideration, I feel that it is more or less of a presumption on my part, as any attempt to cover the entire subject of the management of the second stage of labor in one paper of a few minutes' duration is, on the face of it, impossible; my remarks then must be limited to an effort to consider certain special facts which experience has shown to be important in a survey of a large series of cases both in private and hospital practice.

The maternity case is in general divided into three periods, the prenatal or period before labor begins, the labor period itself, again divided into three stages, and the postnatal. To properly conduct the two latter divisions it is of the utmost importance for the accoucheur to have a comprehensive knowledge of the prenatal or antepartum condition of his patient, and the physician who neglects this important part of his duties, not only runs a risk of future trouble, but does not gather the information which should be of the greatest possible assistance to him in the conduct of the labor itself. Frequent communications with the patient either at the home or office, together with the general and special physical examinations, pelvic measurements, blood pressures, urine analyses, advice as to diet and hygiene, all serve to establish an intimacy, knowledge and confidence between physician and patient without which no confinement can be conducted successfully.

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[1] Read by title at the Thirty-fourth Annual Meeting of the American Association of Obstetricians, Gynecologists, and Abdominal Surgeons, September 20, 1921.

Assuming, however, that this prenatal period has been properly and competently terminated, that the patient has passed through the first stage of her labor, and has attained full cervical dilatation, thereby reaching the second stage, what are the duties of the attendant, first toward the mother's comfort and progress, and second toward the welfare and successful birth of the child?

If we follow the lead of Potter, of Buffalo, immediate intervention on the part of the physician under surgical anesthesia, and the performance of an internal podalic version, settles the question for us at once and there is no need of further discussion. Unhappily, everyone in contact with obstetrical work is not a specialist and has not yet attained Potter's facility with this operation, lacking which it will be wiser for the majority of those caring for confinement cases not to attempt to emulate him, certainly not unless especially trained.

There will be, therefore, a very large number of mothers in whom Nature's efforts will be necessary in order for the labor to proceed, and our position will have to be that of waiting and watching until the presenting part is ready to be born.

In general, in the second or expulsive stage, so long as the pains are regular and strong, the progress downward of the presenting part, steady and continuous as indicated by external palpation, digital examination and evidence of bulging, and auscultation of the fetal heart shows no signs of fatigue on the part of the child, the case need not be interfered with while the passage through the pelvic cavity is taking place. Some degree of analgesia at this time is usually indicated and of the various analgesics, nitrous oxide oxygen, properly administered, probably holds the first place. The method of administration is important and should be as follows: The anesthetist with a full bag of the nitrous oxide and oxygen mixture is seated by the bed and has one hand placed on the patient's abdomen over the fundus. At the first sign of a contraction which the anesthetist will note before the patient feels any pain, she is instructed to take five or six deep breaths of the gas. This will produce in most cases a considerable relief from suffering, indeed, in many almost entire relief apparently strengthens the contraction and does not injure the child. The same maneuver is repeated with each succeeding pain and continued until the presenting part is ready for delivery when the anesthetic can be pushed to full degree or a change made to ether if preferred by the physician.

Too much stress cannot be placed at this time upon the importance of encouraging the patient as to her progress. Repeated assurances by the attendant that all is going well, that the termination of the event is momentarily expected, all serve a marked purpose in keeping up the courage of the mother and stimulating her to further efforts.

Constant watch should be kept to see that the bladder does not become distended and if the patient cannot voluntarily void, the full bladder should be emptied by means of careful aseptic catheterization.

It is assumed that the rectum has been emptied by means of an enema late in the first stage in all instances.

In the normal case the foregoing practically covers all that is necessary to be done while the presenting part is passing downward through the pelvic cavity until it has arrived at the perineum. When this stage has been reached, and a vertex is presenting, we have a wide diversity of opinion as to the proper procedure. Many obstetricians notably DeLee of Chicago, Polak of Brooklyn, as well as others of prominence, are giving much attention to the so-called prophylactic low forceps, usually preceded by a median or lateral episiotomy, thus practically obliterating the perineal stage. It is argued that much delay to the mother and child is thus eliminated in addition to securing a clean cut wound in the perineum which is easily repaired and heals well, in contradistinction to the jagged laceration which may result if the perineum is simply left to itself, or is "supported" in the usual manner. This has been emphasized by Harrar of New York and Pomeroy of Brooklyn.

Others believe in "ironing out" the perineum before the presenting part has descended, claiming that in this way lacerations are avoided and repair made unnecessary. Violent opposition to these views and manipulations has developed, but after a very large experience and having tried all of the procedures advised, I am inclined to believe that in the average primipara, under suitable surroundings, in the hands of a competent obstetrician with full anesthesia and proper technic, an easy low forceps where no pressure is applied by the blades and which is preceded by an episiotomy just as the perineum begins to distend, offers a more satisfactory means of delivery than by waiting for Nature to effect the birth. The average multipara, on the other hand, is probably better let alone, if progress is satisfactory. It is not expected that everyone in the audience will subscribe to this statement and I certainly do not advise anyone to attempt it as a routine procedure unless skilled both in diagnosis and the use of obstetrical and gynecological instruments.

Breech cases, if proceeding normally, are best let alone until the breech is fairly well expressed, when the delivery should be terminated in the proper manner, by manual extraction.

Pituitrin may be administered after the birth of the child, *before* the delivery of the placenta, and it is believed that by its use, firmer contractions of the uterus take place, less bleeding occurs, the third stage is shortened, and repair of the perineum is made more easy. Retention of the placenta has not been observed in a large series of cases, and after-pains are notably decreased in patients where it has been employed. On the other hand the use of pituitrin to stimulate the expulsion of the child is rarely if ever to be advised, then only in patients in whom no disproportion between the mother's birth canal and the child exists, where the cervix is entirely effaced, and then only in doses of two or three minims. Its use for this purpose is assuredly dangerous and not to be ordinarily recommended or employed except in cases that are so few that they can practically be disregarded.

As stated in the beginning of the paper, the reader recognizes that these remarks are merely in the nature of suggestions on special phases of the subject and if a discussion of some of the points brought out can be evoked, his object in bringing them before you will have been attained.

IMPROVED MATERNITY CARE AS A PUBLIC HEALTH QUESTION.[1]

Can we Provide for the Same by Legislative Enactments?

BY

GEO. W. KOSMAK, M. D., F. A. C. S.,
New York, N. Y.

The increasing attention given to questions of public health is conclusively demonstrated by the rapid strides during the past few decades in this domain and which has also found expression in widespread agitation and propaganda now so generally prevalent in both lay and professional circles. The campaigns against tuberculosis, the contagious diseases of children, typhoid, malaria, and other illnesses have now been succeeded, it seems, by an almost worldwide propaganda for better maternity care and infant welfare. In this country the latter movement was inaugurated by the founding of numerous local bodies, made up in part of physicians but more largely of public spirited laymen, to render relief both practical in providing a better milk supply, and educational in furnishing mothers instruction in how to care for themselves and their babies. The success of their endeavors and the proof of their necessity stimulated municipal and State authorities to take up this work either independently or in cooperation with these private organizations. For some years previous to the late war, a national organization, now known as the American Child Hygiene Association, had endeavored by publication and otherwise, to coordinate the varied interests in this field, interests which are scattered through communities both large and small and which because of their sentimental appeal have gradually developed to such an extent that they have been submerged in a countrywide agitation and propaganda for national legislative support.

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[1] Read at a meeting of the Medical Society of the County of New York, October 24, 1921.

The interest which the public, both as individuals and in organizations, has shown in this matter, behooves us as physicians to recognize these sentiments and to lend our constructive advice and technical knowledge in guiding the same along the proper channels.

In any discussion of the subject of maternity care as a public health question we must carefully bear in mind the limits of our interests in the same. The strictly technical features are so closely interwoven with those of an economic and social character that the latter, because of a sympathetic interest, may be developed to almost overshadow the purely medical aspects. Before proceeding to a more detailed discussion of the subject it is necessary however to bear in mind that the question of improved maternity care is largely a medical one and that while the economic and social factors are important they should not lead us astray in any concerted attempt to remedy the situation. There is no field in which false sentiment can lead to such fatal errors. Childbirth and the preparation for the event arouses in the minds of every one a feeling of sympathy or even pity and it is well known how dangerous an overabundance of these sentiments may become in the furnishing of practical relief. We all realize how important the childbearing life of a woman is to the community and to the state,—the whole welfare of the nation is linked with healthy motherhood, the ability to bear and to rear children. As physicians a great deal of the burden and responsibility for securing the same rests upon our shoulders. Whether we have fully met the need may perhaps be questioned but under the circumstances and surrounded with many attendant difficulties, it may be said that we have done the best we could.

The problems of infant welfare and improved maternity care are so closely bound together that they may justifiably be considered as one. Although as obstetricians we concern ourselves particularly with the morbidity and mortality of childbearing yet a certain responsibility attaches to an excessive mortality in infancy, particularly where this is dependent on a lack of proper prenatal care or the inability of the mother to nurse her baby on account of invalidism due to labor or other causes.

A great English authority, Sir Arthur Newsholme, states that excessive mortality in infancy implies excessive mortality in later life and that there can be no reasonable doubt that in the countries having a high infant death rate there is more sickness and a lower state of health in youth and in adult life than in countries in which the toll of infant mortality is less. The same authority well states that the most sensitive index we possess of social welfare and a sanitary administration is the infant mortality figures. A growing recognition of these facts has been noted in all civilized countries during the past two decades and as a result many attempts have been made to secure the desired improvement by legislative enactments.

The propaganda in this country in favor of national recognition of the maternal mortality depending on childbirth is to some extent based on a study made by Dr. Grace L. Meigs of the Children's Bureau of the U. S. Department of Labor published in 1917. This report is an admirable study of this important subject and it might be well to consider in detail some of the facts brought forward in the same. Dr. Meigs claims that in 1913 in this country 15,000 women died from conditions caused by childbirth of which 7,000 were cases of puerperal fever. It is also pointed out that the death rate per 100,000 population from childbirth was only a little lower than that from typhoid fever and that this rate would be almost quadrupled if only the group of the population which can be affected, namely, women of childbearing age, was considered. It is also stated that in 1913 childbirth caused more deaths among women from 15 to 44 years of age than any disease except tuberculosis. In the group of 15 foreign countries only two were shown to have a higher death rate from this cause than the United States. Dr. Meigs claims that the death rates show no appreciable falling off during the period of 1900 to 1913 although this same lapse of years has been marked by a revolution in the control of certain other preventable diseases such as typhoid, diphtheria and tuberculosis.

The author of the report believes that the standards of obstetric care in this country are low and that this results chiefly from two causes; (1) general ignorance of the dangers connected with childbirth and of the need of proper hygiene and skilled care in order to prevent them; (2) difficulty in the provision of adequate care due to special problems characteristic of this country. She concludes her very interesting study with the statement that improvement will only come about through a general realization of the necessity for better care in childbirth and that if women demand better care physicians will provide it, medical colleges will furnish better training in obstetrics, and communities will realize the vital importance of community measures to insure good care for all classes of women. (Please observe that, although a member of the staff of the Children's Bureau, no recommendations are expressed along the lines suggested at a later date in the Shepard-Towner bill.)

Further statistical evidence has been brought forward by those interested in this subject to show that the mortality rate from childbirth has not undergone a reduction proportionate to that secured in other diseases and the statement is freely made that the United States, as a matter of fact, stands fourteenth in the list of nations with respect to its death rate from puerperal conditions.

As far as infant mortality is concerned, however, we find that in later statistics now at hand, very satisfactory reductions in infant mortality have been noted. In this connection attention may be called to the most recent figures presented by our local Department of Health which show a reduction in the infant mortality rate in New York City from 273.6 per thousand children born in 1885, to 81.6 in 1919, although the number of births has been steadily increased. There is probably no other city in the country which shows an equally rapid decline in its infant mortality rate and those who have presented this report believe that the important factors contributing to the decline are better milk, breast feeding, baby health station service, visiting nurses, better control over contagious diseases and improvement in municipal sanitation. The statistical reports of the American Child Hygiene Association seem to show equally favorable figures for the entire United States so that, in so far as infant welfare work is concerned, we may claim that whatever factors should be credited with the same they have at least accomplished their purpose.

A less satisfactory condition prevails however in regard to the mortality from childbearing, for septicemia and eclampsia among other conditions, still claim an undue number of victims. While puerperal septicemia, in most instances at least, must be regarded as a form of wound infection, it does not seem to have been as favorably influenced as other forms of septic infection. (Thus we find that in the Borough of Manhattan during the year 1920 available statistics seem to show that one mother died for every 205 babies born, while in Greater New York, one out of every 250 deliveries ended fatally for the mother from septic infection.) In other words, the mortality from puerperal infection remains practically the same for the past twenty years and the mortality from child birth in general is second only to that from tuberculosis in women of reproductive age. The death rate from puerperal eclampsia seems to have been equally high and if we add to these, deaths from the ordinary and extraordinary accidents of labor, including those over which little or no control can be exercised and those which are due simply to poor judgment and execution, the toll of lives must be admitted to be a large one. Of course we must expect that in the carrying out of the processes of gestation a large number of complicating factors enter and many of these are out of our control. On the other hand, it has been amply proved that with appropriate prenatal care and skilled attention during labor, the maternal morbidity and mortality can be much reduced. I am making these statements in a general way so as not to burden your mind with statistical details, the sources of which are easily obtainable.

The assertion has been frequently made that only the rich and the very poor obtain adequate obstetric care. This is secured for the former by their ability to pay for skilled attention and in the other case by the provisions made through charitable agencies which provide adequate attention before and during confinement. If the foregoing facts are pondered it is quite natural that a propaganda should arise in which an attempt would be made to provide women unable to obtain it otherwise, with such necessary care through the medium of public agencies. The development of this idea might readily lead to extreme measures and it is well to analyze the proposal thoroughly before proceeding to steps in which exaggerated sympathy rather than reason dictates the course to be pursued. Progress to be satisfactory must be slow and thorough coordination between the medical and the contributory factors must be developed. We cannot accomplish by radical legislation the solution of a problem which is purely personal, by methods which savor of the dictatorial, which offend the sense of liberty of action as we understand it in this country.

Health legislation of the past has been largely concerned with the insertion in the statute books of sanitary regulations rather than with measures tending to directly prevent illness. Within recent years, however, more direct legislation has been introduced tending toward the preservation of health in the individual and when this was attempted quite naturally opposition was aroused because in our individualistic scheme of life, interference with personal liberty or desire could not be well tolerated. Nevertheless people soon began to realize that for the benefit of the community they as individuals had to submit to certain definite regulations even if they were personally disagreeable. We thus find growing up a new set of health rules and restrictions that have been adopted by various communities according to their needs. In fact many of these regulations include actual home visiting by public authorities. While the growth of this system has been of value in numerous ways and undoubtedly has brought about a reduction in many groups of illnesses, there must necessarily be limits to which such methods can be applied. Moreover the fostering of a community spirit which has become so prevalent in recent years has done much to bring about an acquiescence to the method which might not have been obtained had the supervision been directed through a channel further removed from the home of the individual. The assistance of the medical profession in such a scheme is paramount and physicians have therefore been urged to cooperate with health authorities in this work. To further the scheme, municipal or state health centers so called, have been established and the members of the medical profession asked to send their cases to these centers for diagnosis. Undoubtedly abuses have resulted and the popularity of the scheme in so far as the profession is concerned has suffered greatly. The distinction between physicians and others employed by the State and those who practice as individuals has gradually opened up a gulf of separation which has steadily grown wider and is not yet bridged. Moreover, unrestrained lay interest in many of these schemes has resulted in further opposing the profession to the same.

There is no doubt that the institution of a public health center exerts a wide educational influence and a knowledge of personal health and hygiene must spread. If such an ideal condition could be brought about and the giving of advice divorced from treatment perhaps less opposition would be generated but it is a difficult matter to separate the two. It would mean the gradual recognition of a system of State medicine which in this age at least we are not prepared to accept for the United States.

Maternal and infant welfare being of perhaps greater popular interest than any other topic in the field of medicine, more concerted and serious attempts have been made to bring it under the control of central governmental supervision and authority, but admitting, as we already have, that the situation is in need of improvement, can we hope to accomplish this end by such widely heralded measures as the recently proposed[1] Sheppard-Towner bill? It is difficult to discuss the subject without reference to this measure because of the nation wide propaganda in its behalf,—a propaganda supported by women as a political entity, by many welfare organizations and by a wave of popular sentiment, much of which unfortunately is based on an improper understanding of the bill and what it proposes to do. This bill may be summarized as the most radical type of legislation which has ever been proposed in this or any other country, for it seeks to establish through the medium of a minor governmental bureau a system of close supervision and direct federal financial support of certain essential functions of the individual States. No one can deny the right of the national government to take an interest in maternal and infant welfare work, for the wellbeing of the nation depends as already stated on a healthy mother, able to properly rear her offspring. But whether the desired end can be obtained through such means is a questionable one. The interest excited by this proposed bill is so great and its appeal so nation wide that any opposition to its passage at once calls into question the sincerity of the attitude of such opponents. Physicians have been accused of undue selfishness because they have opposed its passage, a very unjust accusation to make, because every thinking person must necessarily be in sympathy with the objects of the measure. Objections can be directed merely to the means embodied in the bill for the ostensible correction of a condition that good and unbiased medical judgment regards as a problem to be solved otherwise. The mere appropriation by the Federal government of funds on a fifty-fifty basis, the expenditure to be supervised through the head of the Children's Bureau of the Department of Labor without control and the carrying out of the act largely through visiting nurses, constitutes a measure that would effectually bar rather than further the progress of medicine along these lines for many years. For it would take out of professional auspices the carrying on of a strictly medical work and judging by its accomplishments in the past, the work of this lay Bureau would be largely of a sociological character and constitute an entering wedge for paternalistic and communistic schemes with which this country is not in sympathy.

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[1] (and now accepted,)

In bringing forward objections to the Sheppard-Towner bill, the medical profession must accept a certain responsibility in substituting constructive measures that will satisfy this desire for better maternity care to the masses of the population. While admitting the possible shortcomings of obstetric art and science, I believe that it is only through professional rather than lay efforts that the necessary results can be accomplished. Admitting that septicemia and the toxemias of pregnancy constitute the largest element in the mortality of childbirth, how much can we reduce these factors by advances in obstetric methods? Radical interference with the course of labor has been accused as one of the factors in an increased mortality. But can we say that this is true,—can we say that more sepsis has resulted since these radical methods have come into vogue, and are they being done in a sufficiently large number of cases to influence the result as a whole? Moreover, they certainly have nothing to do with the reported increase in the incidence of the toxemias of pregnancy. In this connection attention may be called to the fact that in Germany during the height of the war, when the nutrition of the nation was reduced to a low ebb, eclampsia became almost unknown. We may also note that during this time probably less supervision of pregnant women was exercised than at any other and while a reduction in the incidence of eclampsia may go hand in hand with that of the birth rate during this period, the proportionate decline is much larger. Thus, German observers who have carefully studied the question are impressed with the fact that the reduction in the incidence of eclampsia was entirely due to the compulsory change in the diet when fats and proteids were reduced far below the amounts usually consumed. May we not assume that the unfavorable statistics as regards eclampsia which have been published a short time ago by the Metropolitan Life Insurance Company are due to the more abundant and richer food supply which our people have become accustomed to in recent years? Prenatal observation is unquestionably more widespread in this country than formerly and numerous collections of statistics have been produced to show that proper prenatal supervision is the most important factor in reducing the complications of pregnancy. If this is true why are we constantly reminded of the fact that eclampsia is on the increase? It seems to me that these two statements are at variance.

The American Child Hygiene Association has carefully tabulated and compared the figures of infant deaths occurring in 657 cities of this country with over 10,000 population which were in the so-called death registration area of the United States. In 492 of these cities which were in the birth registration area the total number of births could also be ascertained. It is interesting to note that a gradual reduction in the infant death rate has taken place within the last two years and particularly is this to be noted in the smaller cities where progress, as estimated by a falling infant mortality rate, had unfortunately been slowest. The infant mortality for all the cities reported comprising a population of forty-two and one half million, or about 85 per cent. of the total urban population in the death registration area is 9% per cent., Dr. Philip Van Ingen, Chairman of the Committee of the Association referred to, in commenting on these figures, states that the rate may be regarded as fairly close to that of the entire United States and it therefore means that 25,000 less babies died in 1920 than would have, had the same conditions existed as did five years ago.

The health of children depends so largely on that of their parents that it is no exaggerated claim that the care of the expectant mother should be considered the foundation of future health for the child. It is the belief of those who enthusiastically support the idea that the central government should manifest a paternalistic spirit sufficiently extended to compel every expectant mother to register and thus come under the direct influence of a visiting nurse system. It is questionable however whether this involuntary system of espionage would be welcomed by those whom it is sought to reach and whether the individualistic conception of personal freedom and independence would not revolt against such compulsory recognition of what most women regard as a strictly personal matter. The desirability for proper care of those expectant mothers as may be too ignorant or unable to provide the same for themselves, must be developed in ways that will not lead to such conflict. It seems to me that more can be done by a process of education that would appeal to the instincts rather than by any compulsory system of registration. Pregnancy is not a disease and its presence is not a source of danger to the pregnant woman's surroundings. It is unfair to compare gestation with scarlet fever, diphtheria or other contagious diseases and subject the mother to the possibly undesired attentions of a public visiting nurse system. Advertise the fact that pregnancy can in most cases be freed from its attendant dangers and impress upon the prospective mother the desirability of taking care of herself and you will soon gain converts to an educational propaganda that would be less effective if forced upon those whom it is desired to benefit. The task of providing information for a pregnant woman is difficult. It requires consideration and sympathy and the necessary attentions must not be savored with the aspect of governmental authority. While pregnancy is naturally of importance as an element in the welfare of the State, the act itself is a strictly personal matter and should not be regarded in any other light.

Granting the claim that childbirth in this country has been attended with a maternal death rate in need of revision and that a similar condition applies to infant mortality, are we not compelled to admit from statistics presented by authoritative bodies that an improvement has taken place in the last ten or fifteen years? Do not the figures gathered by the Rockefeller Foundation and from the records of the New York Health Department show an admirable change for the better? Do not these as well as other similar figures show conclusively that where a community spirit and interest has been aroused good results have followed? In the rural districts particularly and perhaps in some of the smaller cities and towns, similar improvement has been somewhat slower but nevertheless it must be admitted that an awakening is taking place and that some of the deplorable conditions found by various investigators in the rural communities are in process of being improved. I desire to reiterate these statements for the purpose of bringing forward the claim that further improvement will result from the continued development of local interests in this important problem and that what has been accomplished thus far should be a matter of greater pride in the particular localities where it has been done, for the accomplishment of this end was attained without the help, either through financial assistance or supervisory restrictions, of the national government. I think I am safe in claiming that further improvement will result if this method is extended, for it is a method particularly applicable to this country in which we live,—an empire made up of constituent states, each powerful in itself, each capable of administering to its own wants and, while made more powerful by a coordination of its interests with those of other States, each able to accomplish what it needs through its own individual efforts. I believe that it is in this assumption that future progress lies and that the good work for women and children which has been begun in so many communities throughout the land can be further developed until the United States occupies a plane as high, or even higher, than those with which we are so often compared. If the wider aspects of the question demand that the national government recognize the possible shortcomings in our plans for the welfare of women and children, then let this recognition take the form which it has in other great departments of the government. The central government cannot disassociate itself from a paternalistic scheme if it attempts to regulate or interfere with local measures of improvement, be this material or otherwise. A great deal more dignity and credit will redound to a central government if it exercises its functions in a purely supervisory capacity, stepping in where need be to help along by good advice, suggestion or precept and carefully avoiding direct control or direct financial support. Our people are not constituted to tolerate this and governmental interference in other ways has so often proved a dismal failure that it should not be repeated in this instance. If all the medical interests of the national government were concentrated or coordinated in a department of national welfare or in a national department of health, the problems in which we are interested could readily enough be made part of this general scheme. The Public Health Service is at the present time fully capable of taking up the national government side of this important matter and whatever is done could be done in a dignified way from the medical point of view and free from the socialistic or paternalistic aspect with which so much of the work of the U. S. Department of Labor has been characterized.

It is my firm belief that improvement in obstetrics will result more rapidly and more directly from a recognition of the fact by the medical profession, by an improvement of our teaching facilities in obstetrics, by an acknowledgment of this as one of the major branches of medicine and by a full realization of the fact that improved maternity and infant care is a medical problem pure and simple with certain underlying economic factors, but a problem that must be kept free from all schemes for the endowment of motherhood, compulsory health insurance, or the subtle influences of the feminist movement.

Participation by the national government in a scheme for improved maternity care must be limited in the manner prescribed in order to insure its success and to prevent the resentment and probable disaster which invariably attends the exercise of such autocratic authority as we find embodied in the provisions of the contemplated Sheppard-Towner bill. The statement is often made in extenuation of the good character of the Children's Bureau, which is scheduled to administer this act, that it has accomplished much of benefit for mothers and children. I am inclined to question this, for, aside from the very excellent pamphlets on prenatal and infant care prepared by Mrs. Max West, its former chief, and several statistical studies, by special workers, the remaining publications are not only of doubtful importance but so riddled with deliberate nonsense, socialistic theories and worse, that a feeling of wonder is aroused that the government printed and circulated them. And to this Bureau, entirely feminine in its make-up and almost entirely non-professional in its membership, with a social worker at its head, we are asked to pledge and trust the solution of a problem largely medical and demanding for its solution the cooperation and thought of the best minds of the country.

CONCLUSIONS.

In summing up the ideas expressed, perhaps inadequately, in the foregoing paper, I desire to reiterate a statement which we may accept as proven, that while much has been accomplished, much still remains to be done to lower the morbidity and mortality of childbearing. Infant life is safer than formerly and the incidence of many of the complications of pregnancy has been reduced by prenatal care, but remember please that this has been done by a process of education, by supervision, by precept and example, by strictly local and community effort, and without the incubus of a centralized governmental authority and subsidy through financial support. Why cannot this previously successful method be continued? Why must government interference, as already attempted with business, with transportation and other activities be saddled upon the medical profession and its accessory interests, with an equal blight, such as we have often witnessed since the war. I believe that the interests of the national government on the subject under discussion should remain strictly academic, of an advisory, rather than a supervisory character, and that there are agencies already existing, such as the Public Health Service, which can take over such function without the creation or expansion of other governmental bureaus at an enormous and constantly increasing outlay of public funds.

HEMORRHAGES IN THE NEW BORN.

BY

J. R. LOSEE, M. D.,
Pathologist.

THE following remarks refer entirely to the more serious hemorrhages in the new born and no mention will be made of the hemorrhages associated with asphyxia. Of those cases where the life of the infant is often in danger, we have for our consideration the so called idiopathic hemorrhage and hemorrhage due to injury. These babies are not suffering from hemophilia but their condition is peculiar to the first few days of life and where as in the spontaneous variety we are ignorant of the cause I believe that the hemorrhage persists because the hematopoietic system is not complete when born and their blood does not contain the necessary substances to promote clotting. This condition is present in both males and females and several have been seen from one to two years after birth without any history of a recurrence. In a large series of autopsies I have observed that the more premature the infant the greater the danger of hemorrhage. I am convinced after the clinical observation of many of these cases in the past few years that regardless of the cause the treatment is the same for both types.

On account of the difficulty in obtaining a sufficient quantity of blood from an infant it is impossible to carry out the more accurate methods for determining the coagulation time, the prothrombin time and other investigations necessary for a complete study of the blood. Observers have reported both a prolonged coagulation time and bleeding time in some cases, in others the same observers have found a prolonged bleeding time and a normal coagulation time and there is a third type of case where neither the coagulation time nor the bleeding time was increased. Hurwitz has placed this disease in that group which shows lack of prothrombin, yet we have seen cases manifest typical symptoms without a delayed coagulation time. The prothrombin time in three cases that returned after one year was normal. It was not estimated during the course of the disease. Rodda has reported two cases with both a delayed coagulation time and bleeding time that developed definite symptoms of hemorrhagic disease and two others with a delayed coagulation time and a normal bleeding time that showed no signs of it. It is apparent therefore that these cases do not all lack the same element in the blood and it is quite impossible to classify them on that basis.

Hemorrhage is the chief symptom observed. It may be mild, moderate and occasionally the initial bleeding is severe enough to endanger life. The bleeding may occur in any tissue but it is most frequently observed in the subcutaneous tissues, the gastro-intestinal tract, from the umbilicus and in the central nervous system. It has been noticed that after an extensive hemorrhage in one system a very slight or an absence of hemorrhage is found in the others. These symptoms generally occur before the fifth day and they are sometimes associated with fever, absence of nursing and the general appearance of the infant is suggestive that it is not doing well. In some the entire subcutaneous tissues of the back are infiltrated with blood, in others there is an extensive hemorrhage beneath the dura mater, in others nearly all the blood in the infants body is in a cephalohematoma and I have seen cases of gastrointestinal hemorrhage where a complete blood cast of the small intestine was observed at autopsy.

Inasmuch as this is a constitutional disease there is little advantage gained and considerable time wasted by applying local measures, even in those cases where it is possible to do so, by reason of an external bleeding point, and, in spite of the numerous articles on the value of whole blood therapy, the majority of these cases continue to be treated with horse serum, thromboplastin and calcium. It has been shown by Hurwitz that old serum retards rather than hastens the clotting of blood both in normal animals and in those suffering from hemorrhagic disease. He also attributed little value to the use of fresh serum in this condition and says after carefully controlled experiments that it has little effect on the coagulability of the blood. On the contrary our experience at the New York Lying-In Hopsital has shown very good results with fresh normal human serum ever since it was introduced by Dr. J. E. Welch ten years ago. There are certain cases which even serum or whole blood in large amounts subcutaneously will not control and in these we must resort to whole blood intravenously. With this method we not only supply the therapeutic agent necessary to check the bleeding in any part of the body but also overcome the acute anaemia which is threatening life. Even after introducing blood directly into the circulation of these babies I have seen one in a series of sixteen cases recur after twenty-four hours. In this case we were dealing with a type which not only did not have the substances to produce clotting but possibly had sufficient anti-clotting substance in its blood to neutralize that introduced, or it may be that in the cases which do well the introduction of blood stimulates the production of the clotting substances and in those in which bleeding recurs it does not produce such stimulation. It is our routine at the hospital to treat these cases early with fresh normal human serum or whole blood subcutaneously but if the hemorrhage is not controlled by this method transfusion is performed and is followed by daily injections of serum for two or three days in the endeavor to avoid a recurrence. If the condition should recur and life be endangered another transfusion from a different donor is indicated. In those cases where the initial symptom is a profuse hemorrhage and the general condition of the patient is grave or if the case has been admitted after bleeding sometime at home radical treatment is at once instituted.

In the consideration of blood transfusion in these cases the question is repeatedly asked if it is necessary to make the compatibility tests on the infant. The presence of iso-agglutinins in the serum and receptors in the red corpuscles of the infant have been very thoroughly observed by Happ. He has concluded after making sixty-seven tests on forty-nine infants, from one to twenty-one days old, that at birth the group is established in very few instances; that the serum of a newly born infant may contain no agglutinins and his corpuscles be inagglutinable; that the corpuscles become agglutinable before agglutinin is present in the serum; that in only seven of the forty-nine infants tested was agglutinin present in the serum, though the corpuscles were agglutinated in thirty-two cases; and that it was possible to place only eight of the forty-nine cases tested into a definite group. From his observations he says that he has not seen the serum give up an agglutinin or cells give up receptors which have once been acquired and he does not believe that this occurs. He says that it is possible for an infant to acquire further agglutinins in his corpuscles and serum as he grows older which places him in a different group from the one he apparently belonged to in the first few days of life. In twenty-three cases the grouping of the mother was determined simultaneously with that of the infant and on account of the difference between the agglutination reactions of the mother and child he concluded that it was not a safe practice to transfuse the infant from its mother without making the preliminary test.

I have been interested for sometime in the demonstration of agglutinin and receptors in the blood of babies from one to ten days old because it has been in this type of case that I have found its practical application most valuable. The Moss method was followed in the same way as we use it for adults and the serum of one hundred new borns were examined. Of this number thirty-two showed the presence of agglutinins for II or III cells or for both. Six contained agglutinins for II cells, twelve for III cells and fourteen had agglutinins for both. Therefore according to Happ fourteen of these cases could be permanently classified as belonging to type IV, but in as much as the other two classes may develop agglutinins later for either III or II cells respectively, it was impossible to place them in a definite group. The corpuscles of one hundred and thirty-four babies were examined for the presence of receptors and fifteen contained receptors for agglutinins in serum II, fifty had receptors for the agglutinins in serum III and one held receptors for both. It was only possible to place one in a definite group from this series of examinations on account of the possibility of the other sixty-five forming receptors for III and II agglutinins. It is true however that only one or two of this number would do this on account of the low percentage of cases in type I. I concluded therefore that in as much as thirty-two per cent. of one series contained agglutinins and fifty per cent. of another series contained cell receptors that it was advisable to always make our preliminary compatibility tests regardless of the fact that many of these agglutinins are weak and would be diluted somewhat in the process of transfusion.

Both modified and unmodified blood have been used in this series of cases with equally good results. The blood was injected into one of the superficial veins in the cubital fossa of the arm after cutting down and this was accomplished even after cases had been almost completely exsanginated. I am well aware that the longitudional sinus route is the most popular at the present time for all varieties of intravenous therapy, but I am certain that it is not without its dangers in a definite proportion of cases. I have been successful in placing the blood beneath the dura on more than one occasion and have observed others supposed to be proficient in the art do likewise. The final results of such a procedure will not be apparent until early childhood. From forty to one hundred and twenty cc. of blood have been injected depending upon whether it is done for the therapeutic effect, or whether we are also treating the anaemia produced by the loss of blood. In cases where external bleeding is present, as from the cord or skin the result is very apparent for in most cases the bleeding has stopped before the transfusion is completed. A reaction if present, in these cases is manifested by a slight rise in temperature from one-half to two hours afterwards which promptly subsides and the general condition is noticeably improved.

The following is a brief clinical history of sixteen cases treated by blood transfusion. Eight of these had been treated with normal human serum without any result and in one the hemorrhage recurred after blood transfusion. There are seven cases of subcutaneous hemorrhage, three of cerebral hemorrhage following operative delivery, three of hemorrhage from the umbilicus, two with gastrointestinal hemorrhage and one from the wound following circumcision. Two of the babies with cerebral hemorrhage have been reported by their attending physician to be well one year after birth. No neurological examination has been made on these cases however.

1. Baby G, delivered by high forceps and the following day a bilateral cephalohematoma was observed in the occipital region. During the following forty-eight hours numerous subcutaneous hemorrhages were observed over the back and face and there were symptoms of cerebral irritation. Two hundred and fifty cc. of normal human serum were injected subcutaneously during the first two days but as the hematomata were increasing in size and as the general condition of the child was worse seventy-five cc. of blood were injected into the arm vein. Following the transfusion the hematomata gradually became smaller, the general condition improved, nursing was restablished and no more subcutaneous hemorrhages were noticed. Its weight at birth was 4170 grams, when transfused it was 3820 grams and on the eleventh day it was 4005 grams. The child was discharged in good condition on the twenty-first day. The physician reported twelve months later that the baby had been well since leaving the hospital and that it weighs twenty-two pounds.

2. Baby G, was circumsized on the ninth day by a rabbi. It was admitted to the hospital bleeding from the operative wound and all local attempts to control the hemorrhage were unsuccessful. At two A. M. the following morning the child was pale, the general condition was poor and transfusion was performed. One hundred and twenty cc. of citrated blood were injected and the bleeding stopped at once. The patient was discharged four days after transfusion. The mother reported to the Hospital with the baby fifteen months later and said that the baby was well and that there had been no recurrence of the hemorrhage.

3. Baby B, was delivered May 26th after a long labor by a medium forceps operation. On the second day it began to show symptoms of cerebral irritation. On the third day there was some hemorrhage observed beneath the scalp which extended downwards into the neck, at which time the temperature was 99.8° and the general condition was bad. Transfusion was done on the third day and sixty-five cc. of citrated blood were injected. The following day the condition improved and the baby was discharged two weeks after delivery weighing 3440 grams. It weighed 3100 grams at birth. The physician reported eleven months later that the infant had been well since leaving the hospital.

4. Baby D, was a difficult forceps delivery and definite symptoms of cerebral hemorrhage manifested by tense fontanelles, muscle spasm and convulsions developed during the first twenty-four hours. For the following thirty-six hours it was treated with normal human serum, at the end of which time it bled from the mouth, stomach and rectum. General condition became worse, transfusion was performed on the fourth day and eighty cc. of citrated blood were injected. The coagulation time was

twenty-five minutes before transfusion and four minutes following the transfusion. The baby was discharged well on the twelfth day.

5. Baby G, was delivered March 1st by low forceps. Extensive subcutaneous hemorrhages were observed in the back and neck on the third day. Serum was immediately administered early in the morning but the general condition of the infant grew rapidly worse. It was transfused with sixty cc. of unmodified blood. The temperature on the morning of transfusion was 101° and after transfusion it was normal. Sixty cc. of serum were given in two doses on two successive days following transfusion. Its weight at birth was 3150 grams and it was discharged on March 20th in good condition with its birth weight. The mother reported fourteen months later that the baby had been well since leaving the hospital.

6. Baby M, was a normal delivery, hemorrhage began in the first twenty-four hours and it was very extensive from the mouth and rectum. Three hours from the time the first bleeding was observed transfusion was performed and one hundred cc. of citrated blood were given. The following day twenty-five cc. of serum were given subcutaneously. The baby lost little weight and was discharged on the tenth day in good condition. It was seen fifteen months later and the mother reports that it has been well since leaving the hospital.

7. Baby A, was admitted to the hospital four days post partum with extensive hemorrhage from the umbilicus and marked anaemia secondary to this hemorrhage. It was at once transfused with one hundred cc. of citrated blood and the hemorrhage from the cord ceased as soon as transfusion was completed. The cord came off without any further hemorrhage on the eighth day. It was discharged on the tenth day weighing 3500 grams which weight it had when admitted. The infant also showed some jaundice on admission but this had almost completely disappeared when discharged.

8. Baby A, was delivered by low forceps February 29th. There was a small forcep abrasion on the forehead. The infant bled slowly from this abrasion and on the first and second days numerous increasing subcutaneous hemorrhages were observed in the neck, back and face. Baby was transfused on the afternoon of the second day with sixty cc. of citrated blood. Bleeding ceased while transfusion was going on. Twenty-five cc. of normal human serum were injected on each of the following days for two doses. The baby continued to do well and was discharged from the hospital seventeen days after birth in good condition. A report twelve months later from the mother showed that the baby was well and had no recurrence of its condition.

9. Baby K, was a normal delivery on March 2nd. On March 3rd it vomited considerable fresh blood. Two hundred cc. of human serum were given on the third and fourth days but the hemorrhage continued from the stomach. On the fifth day seventy-five cc. of citrated blood were given intravenously. It ceased bleeding, continued to nurse and was discharged sixteen days post-partum in good condition.

10. Baby H, male, colored, presented a cephalohematoma and multiple subcutaneous hemorrhages on the second day following a normal delivery. The general condition of the infant was poor and it was transfused at once with one hundred and fifteen cc. of citrated blood. Twenty cc. of human serum were given on each of the following two days. The infant weighed 3780 grams at birth and was discharged on the fourteenth day weighing 3910 grams. Reports from the mother one year later states that the baby died when seven months old from broncho-pneumonia and up to that time there had been no recurrence of the hemorrhage.

11. Baby F, was a normal delivery, showed numerous subcutaneous hemorrhages on the sixth day which continued to increase in spite of treatment with human serum. It was transfused with eighty cc. of blood by the citrate method on the eighth day and it was discharged on the twelfth day in good condition.

12. Baby R, was a normal delivery and six days later it began to bleed from the umbilicus. Forty-eight hours afterwards it showed marked anaemia, some jaundice

and the general condition was bad. It was transfused at this time with 100 cc. of citrated blood. The baby did very well on the following day but on the second day it began to develop symptoms of cerebral hemorrhage. Subcutaneous injections of whole blood were administered at that time and were repeated but in spite of this treatment the child died four days after transfusion from cerebral hemorrhage and anaemia.

13. Baby W., was a normal delivery and developed a large cephalohematoma which increased in size regardless of treatment by normal human serum for six days. The general condition of the baby grew worse and it was transfused with eighty cc. of citrated blood. Normal human serum was injected subcutaneously after transfusion. It was discharged on the tenth day. Five months later the baby was in good condition and gave no history of a recurrence.

14. Baby K, began to bleed ten days post-partum from the umbilical stump. It was treated with normal human serum for twelve hours but the general condition grew worse and it was transfused at once with eighty cc. of unmodified blood. The bleeding stopped and the infant was discharged in three days. The baby returned two months later in good condition.

15. Baby D, was a colored male infant and showed an extensive subcutaneous hemorrhage in the back on the second day. It was very anaemic and sixty cc. of citrated blood were given on the third day by transfusion. There was some febrile reaction two hours after transfusion. Baby was discharged eleven days postpartum.

16. Baby S, presented a large cephalohematoma which gradually increased in size until the ninth day. There were also some small subcutaneous hemorrhages. It was markedly anaemic and the general condition was poor. It was transfused with one hundred cc. of citrated blood after it had been treated with human serum for two days. The hematoma became smaller and the patient was discharged eighteen days postpartum.

CONCLUSIONS.

1. There is no definite etiology for the spontaneous hemorrhages of the new born but both in this type and in the traumatic type bleeding persists because the blood system is not complete at birth. The addition of normal adult blood is rational therapeutics because it supplies the substances that are necessary to promote clotting.
2. The blood of both the infant and the donor must be examined for iso-agglutinins before transfusion, with the same precision that is customary in transfusing an adult.
3. Sixteen cases of serious hemorrhage in the new born have been reported with one death and whereas in a larger series of cases there would still be a definite mortality, the former percentage has been greatly reduced by the intravenous administration of whole blood.

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A REPORT ON A SERIES OF CASES OF PSEUDOCYESIS.

BY

MEYER ROSENSOHN, M. D.,
Attending Surgeon.

In any active obstetrical service, especially in those where antepartum visits are encouraged in prospective mothers, cases are always seen where an abnormality of one or another kind is encountered. Few are more appealing than those in whom the ardent desire for offspring has led the patients to misconstrue their subjective sensations and to misinterpret the signs which to them mean only the existence of pregnancy.

It is well known that at some time or other in the marital life of every woman there is the desire for the joys of maternity and there are and always will be some females who for physical reasons inherent in themselves or in their mates cannot conceive: of this class there is a certain proportion who will not permit themselves to acknowledge the impossibility and will eagerly grasp any sign which their reading or hearing has told them indicates pregnancy. It is as this stage is reached that they become the subjects of ungratified instincts where the wishes lead to the misinterpretation of their subjective feelings. Occasionally however, it is not the desire which engenders the fallacy; frequently enough, as will be illustrated in the case reported, fear as a result of the subjection to "illegitimate impregnation" is the basis for the idea of pregnancy, though such fear is by no means limited to those who have committed indiscretions. Probably in every practice will be seen patients, married, who for some reason do not desire conception, and yet, in whom all or most of the signs of spurious pregnancy will appear as a result of this fear. It is not necessary to draw analogies with other medical conditions where fear enters as the etiological factor of morbid states; it is regularly seen in medical and neurological, and even in surgical spheres.

In the antepartum service at the Lying-In Hospital, scarcely a month goes by without the appearance of a patient with the history of some, or all of the external manifestations of pregnancy. For the most part, the important point for the patient is the cessation of menstruation; with that as a criterion, and with the mental factor as a spur, conception is assumed to exist and the train of subsequent signs appears promptly. Not infrequently, the menstruation shows only a deviation from the normal in point of duration or character of flow.

During the year, from November 1st, 1916 to November 1st, 1917, notes were made of 10 cases whose ages have varied from 16 to 42. In 8 amenorrhea had been present from 3 to 10 months; in two there had been slight staining at the menstrual time; in all the subjective signs were the distension of the breasts, the swelling of the abdomen with the sense of pressure in the lower portions, and paraesthesiae about the vulva. Of these 10, to a greater or less degree, in 8 there had been the gastric disturbances with the nausea or vomiting in the early months. In 2 in whom the pregnancy as judged by the cessation of the menstrual function, had apparently existed for less than 4 months, no quickening had been felt, while in the other 8, fetal movements had definitely been noted. Of these 8, two had according to the calculations and to the surprise and fear of the patients, gone one month beyond term. Of the 10, in 6 there was a history of increase in weight during the period of amenorrhoea varying from 10 to 35 pounds. On physical examination, in all but one case the existence of pregnancy, certainly to the period or anywhere near the period thought by the patient could at once be positively excluded. Abdominal palpation alone sufficed in most cases, especially where the patients claimed a pregnancy 4 months or more. In all cases a vaginal examination was made and showed no discoloration and no increase in size of the uterus, and no softening of the cervix. In no case was there any secretion in the breasts. In only one case was an examination under anaesthesia necessary, and this was conducted in the operating room under proper precautions.

While all the cases were of interest even for a condition as well known as is the heading of this paper, the details of the following history show the necessity of ever keeping in mind the possibility of the existence of spurious pregnancy. Certainly some very lamentable as well as humorous mistakes might be avoided.

Patient, a single girl, age 16, whose last menstruation had occurred 10 months before she had applied at the antepartum clinic. Opportunity for conception had not been lacking prior to the amenorrhea. For social reasons she had been sent to an institution for reformation and had apparently been kept there for about 8 months, that is up to one month before she had applied at the Lying-In Hospital. During this time she herself had noticed increase in dimensions, especially abdominal and had put on about 24 pounds in weight. She was taken to a hospital where the induction of labor was attempted, apparently, without success. She remained a week, and left the hospital. When she appeared here a month later with ostensibly a ten months' pregnancy, the examination revealed a frank case of pseudocyesis, in whom indiscretion combined with fear had led to suspicion of the existence. The uterus was of normal size, and in normal position, but there was a very fat abdominal wall; there was no physical sign of pregnancy; nor as far as could be determined were there any other stigmata of thyroid deficiency, though this was considered as a possible factor.

CEREBRAL HEMORRHAGE IN THE NEW BORN.[1]

BY

J. R. LOSEE, M. D.,
Pathologist.

WHEN I was invited to read a brief article on cerebral hemorrhage in the new born, I felt certain that a subject had been suggested which was a frequent finding in my postmortem examinations in the past few years. I was disappointed in the total number of cases, for in referring to the records I found that during the years 1919 and 1920 in which there were 9000 deliveries there had been only 69 cerebral hemorrhages in 274 autopsies on stillbirths and infants that had lived from a few minutes to ten days. But 54 per cent of the deaths came to autopsy and no mention will be made of cases diagnosed clinically as cerebral hemorrhage and which either recovered or died without examination.

The above findings are somewhat lower than those of Margaret Warwick[1] who has reported 18 cases of cerebral hemorrhage in 36 autopsies and Parrot who found 26 subdural hemorrhages in 34 postmortem examinations. On the other hand Weyhe[2] reported 12 per cent. in 959 autopsies and Dohle[3] observed 13.7 per cent in his series. More recently Browne[4] in a study of 200 consecutive cases of stillbirth and neonatal deaths observed 29.5 per cent. due to cerebral hemorrhage.

A careful consideration of these cases demonstrates that there are different periods during labor, delivery and the first hours of life that hemorrhage takes place. Premature and full term infants have been delivered spontaneously with short easy labors and a definite cerebral hemorrhage has been observed at autopsy which no doubt was an intrauterine occurrence. Others have taken place during operative delivery while still others have developed during the first twenty-four hours of life, many of which probably began to bleed at the time of delivery but did not manifest symptoms until later. Then there are those cases associated with hemorrhagic disease of the new born occurring in the first few days which suddenly develop signs of an extensive cerebral hemorrhage after a convulsion without any premonitory symptoms. In my series there were 26 stillbirths at term and 8 prematures; two term cases and 6 prematures were delivered spontaneously. Hemorrhagic disease was the cause of 4 deaths and I do not think that this condition can be held accountable for the origin of the hemorrhagic lesions in stillbirths and those dying in the first hours post partum.

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1. Read at a meeting of the ....

Most authorities agree that the cause of cerebral hemorrhage in the new born is due to intra-uterine asphyxia, trauma at the time of delivery and hemorrhagic disease. In intra-uterine asphyxia we have as a cause the many conditions that may interfere with the foetal circulation resulting in impaired oxygenation of the blood, congestion and distention of the delicate cortical veins which often rupture at their entrance to the superior longitudinal sinus. In the premature, the vein walls are more delicate than in infants at term and they are likewise less able to stand the excessive pressure associated with congestion. I have observed at autopsy stillbirths at seven and one-half months, having blood clot beneath the dura over one entire hemisphere of the cerebrum and this clot had been there long enough to have contracted and formed two separate portions, one serum and the other corpuscles. In the long dry labor in which there has been considerable pressure on the foetus and marked moulding and overlapping of the parietal bones there is not only congestion of the cortical veins but tension on them already over distended and besides in the operative deliveries hemorrhage is more frequent following breech extraction with or without version than with forceps. It is therefore quite evident that the injury is not always due to direct trauma from without. In this series hemorrhage was twice as frequent in breech extractions as in forceps operations. Cases are on record where there has been a laceration of the tentorium cerebelli or falx cerebri with associated rupture of the veins and hemorrhage. It is not always possible to demonstrate a rupture of these veins and the hemorrhage is at times an extravasation through the vessel walls. When a head is born, the pressure is taken off of it and with an associated slow delivery of the body the uterine contractions force the blood from the body into the head with marked congestion and stasis.

The sudden hemorrhage occurring from the end of the first 24 hours up to the sixth and seventh day and often associated with bleeding in other organs is nearly always attributed to hemorrhagic disease in the newborn. There is reason for this not ceasing because there is both a delayed bleeding time and coagulation time. Whereas we have no means of explaining the onset whether it takes place in the central nervous system or elsewhere we do know that it does not stop because these infants have not the necessary substances in their blood to promote coagulation. There are certain cases occurring in the second and third day with a history of an operative delivery in which it is very difficult to determine even at autopsy whether it is an asphyxiation in origin or whether it is spontaneous bleeding or both.

The symptoms of cerebral hemorrhage in these infants depend chiefly on the size of the hemorrhage and on its location, for in as much as a small hemorrhage in the vicinity of the medulla gives rise to alarming signs a larger hemorrhage in other areas may go unobserved. Cases have been seen where the symptoms developed sometime after the initial hemorrhage took place and it is quite possible that there was an increase in the original lesion rather than a sudden new hemorrhage. There is but little doubt that after difficult deliveries and long labors there is often a small amount of fluid blood beneath the dura which is insufficient to cause symptoms but it does not increase and is absorbed. Kundrat[5] has observed at autopsy in children several weeks old, pigment in the meninges and other evidences of extravasated blood. The difficulty so often encountered in establishing respiration in the new born after a long or operative delivery is undoubtedly central in most instances and is either an asphyxiation or hemorrhage in that area. If this asphyxia disappears rapidly the infant will breathe and fully dilate the air vesicles of the lungs; but if the condition is marked and associated with hemorrhage breathing is established for a time and then ceases after a few hours. All of these cases show more or less cerebral hemorrhage at autopsy, lungs with only a few superficial air vesicles dilated, hemorrhages of various sizes beneath the parietal and visceral pleura, the peri and epicardium and at times in other viscera. We have all observed the type of infant which alternately becomes cyanotic and pale and dies in 48 hours. This condition is said to be due to sub-tentorial hemorrhage and pressure on the medulla but how many times has a clinical diagnosis of large thymus or congenital cardiac lesion been made when the real lesion is in the head.

Then again we have for consideration the diagnosis of hemorrhage in infants that have done well for the first 48 hours when there occurs a sudden convulsion, spasm of extremities, strabismus, marked pallor of the skin of the whole body, weak sharp cry, a tense fontanelle and a slight facial oedema. With such a train of symptoms as the above the diagnosis is simple but without the tenseness of the fontanelle and without the pallor it is at times difficult. In these cases lumbar puncture will aid in the diagnosis providing it is done promptly before clotting takes place because in practically all sub-dural hemorrhage blood finds its way through the delicate mesh work of the arachnoid. A differentiation can also be made from meningitis in this way which disease however is rather uncommon in the new born but at times a small amount of blood in the subarachnoid space does produce typical symptoms. Hemorrhage at the base associated with fracture of the skull and laceration of the dura sometimes causes bleeding from the anterior nares, ears and mouth simulating a condition of the fractured skull in an adult.

The treatment of this condition may be classified into prophylactic and curative. For the stillbirths at term and infants which died in the first few hours the prophylaxis rests with the obstetrician but in spite of his best judgment these cases will occur. It has been suggested at the Lying-In Hospital to give these babies of difficult delivery one or two subcutaneous injections of human serum or whole blood which is harmless and which may prevent hemorrhage or stop a small oozing that is going on without symptoms. With the hope of being able to determine if hemorrhage would take place in this type of case I have examined the bleeding time and coagulation time of 10 new born infants after long difficult labors and deliveries. They were examined on the first, third, sixth and ninth day and two showed both a definite increase in coagulation time and bleeding time on the third and sixth day but they developed no symptoms of hemorrhage, remained normal throughout and were discharged.

If the infant survives the hemorrhage we have in many cases to look forward to the unfortunate sequelae of lack of development in early childhood, epileptiform convulsions and the various paralyses, for which little can be done at that time. Once a hemorrhage is established, either traumatic or associated with hemorrhagic disease of the new born we have two conditions to meet, first stop the bleeding and second remove all blood from beneath the dura. With the administration of normal human serum or whole blood subcutaneously and whole blood intravenously bleeding is controlled in most instances. Transfusion has been objected to on the grounds of increasing blood pressure but if the results of controlling an oozing from the cerebral vessels is as prompt as I have observed in other portions of the body particularly from the umbilicus where it can be accurately estimated, I see no objection to it.

The removal of the blood from beneath the dura is a much more difficult problem. Both Foote[6] and Sidbury[7] report excellent results from drainage of the subarachnoid space by lumbar puncture which procedure seems possible providing the blood is entirely in the subarachnoid space and you can act promptly before it becomes clotted. In my experience I have not had the good fortune however to observe any appreciable lessening of the tension in the anterior fontanelle after lumbar puncture. In the 69 cases autopsied 58 showed both clotted and fluid blood and 11 fluid only, which of course is not a fair estimate of the relative proportion of clotted and fluid blood in the few hours after the onset of hemorrhage. At any rate lumbar puncture is well worth trying and its success depends upon the time between the onset of the hemorrhage and the operation and also on the degree of coagulability of the blood in the given case. I have seen cases with undoubted cerebral hemorrhage after being treated with normal human serum recover and go home. I recall three of these cases that are now, two, three and four years of age and at the present time they are developing like normal healthy children.

Before considering the operation of decompression it is well to determine as far as possible the location and extent of the lesion for in many cases bleeding is more or less general and in this series of 69 cases I have observed it over both hemispheres in 10, over one hemisphere and beneath the tentorium in 12, bilateral and beneath the tentorium in 16, bilateral, beneath the tentorium and in the ventricles in 23, beneath the tentorium and in the ventricles in 7 and epidural in one. In no case did I find hemorrhage in the parenchyma proper or laceration and destruction of the brain, but at times I have observed a clot sufficiently well formed on the surface to have caused a definite depression.

Cushing[8] and other operators have performed decompression operations with varying results. Whether or not to decompress some of these cases is a question of careful surgical judgment. On the one hand if you have seen cases of partial or complete invalidism in later life you feel that the unfortunate may at least have been given a chance and on the other hand with the few successful results from the operation and with the fact that some apparently completely recover without operation you are in doubt. The difficulty of removing the blood from beneath the tentorium and at the base even by operating on both sides is indeed quite obvious. If decompression is performed I believe in making a flap of the whole parietal bone rather than working through a small opening with the resulting hernia in many instances. However, in as much as I have not had surgical experience I do not feel that I am capable of advising on this matter but will hold it open for discussion. At best and in any event it is an operation with a large element of chance and one full of detail and extremely careful technique.

Conculsions.

1. Cerebral hemorrhage is a most constant autopsy finding in intra-uterine deaths and in infants deaths during the first few days of life.
2. Intra-uterine asphyxia, trauma and hemorrhagic disease in the new born are the most common causes of this condition.
3. The clinical picture of cerebral hemorrhage in the new born is usually sufficient to establish a definite diagnosis.
4. Lumbar puncture will determine the diagnosis sometimes in the doubtful cases but its value in draining blood from the entire sub-arachnoid space depends upon certain conditions mentioned in the text.
5. The success of the operation for decompression depends upon the location and extent of the lesion.

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A CASE OF TYPHOID FEVER COMPLICATING PREGNANCY

BY

MEYER ROSENSOHN,
Attending Surgeon.

THE relative infrequency of typhoid fever as a complication of pregnancy, as well as the unusual features of both conditions as presented in this patient, are sufficient cause for reporting this case.

I. K., age 28 was admitted as a private patient to the Lying-In Hospital on March 18th, 1918. Her past history was negative; the significant features of her present history were a pregnancy of four months duration with the development two weeks before admission of jaundice, vomiting and fever. Her urine had been examined microscopically and found negative, a blood culture and a Widal were negative and the diagnosis with which the patient was admitted was toxaemia of pregnancy.

On March 19th, the day following admission, under appropriate anaesthesia, after a bilateral incision of the cervix, a male fetus was delivered by version, the placenta was extracted manually. A blood culture taken on the operating table was reported on the following morning as being positive for typhoid bacilli. This was confirmed by a second culture.

The temperature which on admission was 103°, and then after a remission rose to 105°, fluctuated about 102° with a pulse of 120, the febrile reaction having the appearance of a second week typhoid. Clinically the patient seemed pretty sick and yet not so profoundly toxic or depressed as one sees occasionally or as might have been expected with so stormy an onset and following the manipulation to which this patient had been subjected.

On April 13th, 26 days after admission, there was a chill and rise of temperature to 103.2°, but no evidence of any complication, nor was there any change in the lencopenic blood picture. Except for some slight hermorrhage the patient ran a moderately severe course. On May 2nd (45 days after admission, probably the 8th or 9th week of her illness) in the early morning the patient complained of severe abdominal pain and the temperature rose to 105.8°. When seen about an hour later, there was considerable tenderness and some rigidity in the right iliac fossa, with some increased distention; there was no fluid in the flanks and no obliteration of the liver dullness. The white blood count which 3 days before was 5600 with 58 per cent. polynuclears was, when taken 3 hours after the acute onset, 2800 with 56 per cent. polynuclears. An operation by Dr. A. A. Berg undertaken within 6 hours of the development, showed a small perforation about 5 mm. in diameter, in the ileum a few inches proximal to the ileo-caecal valve; this opening was sewed up and the rest of the ileum was rapidly and gently explored, the entire anesthesia lasting only about 15 minutes. About 6 hours later, a Lindeman transfusion of 865 c. c. was done by Dr. J. R. Losee, because of the patient's poor general condition and marked anaemia. Following the operation the condition improved, the temperature however persisting but on a lower scale. On May 14th, twelve days after the laporotomy, the patient again complained of severe abdominal pain, now located in the left iliac fossa; her white blood count was 17,200 with 83 per cent. polynuclears. Except for the tenderness and resistance in the region complained of, the examination revealed nothing definite. Three days later there was a discharge of considerable pus from the rectum with an almost complete subsidence of temperature, the condition evidently having been a pelvic abscess spontaneously opening into the bowel. Convalescence was uneventful and rapid after this incident, and except for the loss of hair and weakness the patient left the hospital within a short time fully recovered.

Summary—This case presents the following interesting features:

1. Pregnancy of 4 months.
2. Onset of jaundice, vomiting and fever.
3. Induction of abortion for a supposed toxemia.
4. Moderately severe typhoid fever.
5. Slight hemorrhage.
6. Intestinal perforation and operation.
7. Pelvic abscess opening in rectum or sigmoid.
8. Recovery.

TRANSACTIONS OF THE ALUMNI ASSOCIATION OF THE LYING-IN HOSPITAL.

Meeting of November 15, 1921.

Dr. W. A. Rowley, of the Mayo Clinic, read by invitation a paper entitled, "Dental Care During Pregnancy," (For original article, see page 82).

Discussion.

E. H. Raymond, Jr., D. D. S. On the fundamental thesis of this paper it would hardly seem to me that discussion was needed.

The removal of a focus of infection would certainly seem to me to be indicated in pregnancy as well as in conditions of health. It seems that where foci of infection are found about the teeth that they should be removed; so that my discussion of this subject will be confined to certain details of manipulation, and also to the selection of certain cases which it seems would not be desirable for such an operation as extraction. In my own experience with extraction in pregnant women it seems to me it is a very minor matter. I have never known of an abortion and have never heard of an abortion following extraction in my experience, limited though it be, but I have had a certain amount of experience with pregnant women in lying-in hospitals and have never known of an abortion following extraction. However, there do seem to me to be cases where extraction is inadvisable. Those cases would be such as do not show radiographic evidence of focal infection about the roots. Granted that most of the Western school feel more radical about that than we do here in the East, the evidence is somewhat divided. I do not think it is all on the table yet; but where roots do not show radio-loosened areas at their apices it seems to me that they can be saved, and it seems a pity to me to extract such roots, even in conditions of pregnancy, when there is a chance of keeping that tooth a valuable member of the patient's mouth.

Another point which occurs to me is that at the Mayo Clinic, as I judge from the paper, radiographic examinations are only made in those cases which show signs of dental derangement. It seems to me that that procedure might well be carried out in all cases. If we are going to remove focal infection from mouths, it is quite impossible to tell whether it is present without the radiograph. External signs of dental infection are almost negligible. Almost all the signs or all the evidence must be based on the radiograph. So that if this principle were to be carried out to its logical conclusion, it would involve the taking of radiographs in all cases.

With regard to the pathogenic character of the organisms found in these foci of infection, either in pregnancy or in health, it seems to me there is still a great deal to be learned. The presence of the streptococcus is practically invariable at roots. I think that can be set down as an axiom. But the type of streptococcus is a variable proposition. In my experience I have very seldom found the hemolytic streptococcus at root-ends, although there have been a good many references to it in the literature in the last two or three years where men have claimed to have found it. I know it does occur.

I believe that the hemolytic form is a very rare thing in the chronic abscess granuloma.

I believe there is still a great deal to be learned about the pathogenicity of the particular type of streptococcus that is found there. So many diseases have been laid at this door that it seems to me we have to find out more about it before we arrive at any scientific opinions. On the other hand, the volume of clinical evidence proven in all sorts of conditions from the removal of foci makes it imperative that we are on the side of radicalism rather than conservatism.

I think that teeth which do not show loss of the pericementum can be made good teeth after the institution of appropriate treatment. After treatment, repeated examinations of the pulp canals show them to be negative, and I believe they are saved with our present knowledge of the situation. Where the pericementum of the teeth is lost and where there is a chance for the bacterial products in the granuloma to have access to the cementum, that is a very different matter. Here the cementum is full of little lacunae which it is impossible to reach. Those cases, it seems to me, are bad risks.

There is one other point that I would like to raise in the discussion of the paper, and that is the care of the patient's teeth by the patient herself. Every one knows, of course, that the teeth are liable to a great deal of damage during the pregnancy period. It is my opinion that a certain proportion of that damage is due to physiological causes, to changes in the secretions. What those changes are I do not think is very well established: whether it is an alteration of the calcium metabolism is not settled. It is certainly not a chemical matter. That aspect of it has been gone into pretty thoroughly by Professor Geiss, of Columbia, and variations in the saliva and in the caries, during pregnancy at least, have been demonstrated. Pregnant women are very negligent as to the care of their teeth. It seems to me that they are disinclined to make efforts of any kind and particularly so as to the care of their teeth. I have seen patients who take rather punctilious care of their teeth get into a rather shocking condition during pregnancy. It seems to me that during this period you should take the opportunity of asking your patients, or spur your patients on to take much better care of their teeth rather than less care, which is the usual state of affairs, in my experience.

Louis Bauman, M. D. I am not in a position to discuss the speaker's paper from an obstetrical or dental point of view, but your Chairman has asked me to make a few remarks bearing on the biochemical aspect of the subject.

The saliva has been worked on a great deal by Dr. Geiss, of Columbia, as you know, and, as far as I know, there haven't been very many important features that have a direct bearing on this subject in his research.

It has been estimated that a foetus weighing about 3 kilograms contains about 35 grams of calcium oxid and about as much phosphorus pen toxid. These requirements for the foetus and the tendency to acidosis during pregnancy, which is now, I think, generally admitted, tax the calcium and phosphorus reserves of the mother, and it is possible that these demands may be partly responsible for the occurrence of caries and diseases, such as osteomalacia.

We, at any rate, have been surprised at the relatively large amount of calcium that may be lost during short periods of acidosis. It was formerly thought that the ammonia was the index of acidosis, and the older workers on the subject simply computed the amount of ammonia in the urine, and thus obtained, they thought, an index of the extent of the acidosis, but now we know that there is considerable loss of calcium as well, so that during a prolonged period of even mild acidosis there may be considerable loss of calcium. I have been able to find but few determinations of the calcium and phosphorus content of the blood of the mother during pregnancy; that is, determinations that were carried out with our modern methods of microanalysis. One author, however, states that there is a definite decrease in the blood calcium during the later months of pregnancy, so that it may be that the teeth are not supplied with the proper amount of calcium through the blood, rather than any effect of the saliva on the teeth.

The amount of calcium that is lost during a short period of acidosis is far beyond anything that is present in the blood or soft tissues. It must be derived from the bones and, as you know, the teeth, from an analytic point of view, are very similar to the bones; that is, they are largely made up of calcium phosphate, and they contain smaller quantities of calcium carbonate and some of the other bases in minimum amount, so that the teeth may give up a small part of their calcium perhaps during pregnancy.

Now, if we should in a large series of cases find a diminished amount of calcium in the blood and phosphorus, which is equally important, then it may be wise to insist on the administration of rather large quantities of milk during pregnancy, for milk, as you know, is one of the foods which s richest in calcium. In more extreme cases cod liver oil may be administered. This has been found to be of remarkable value in rickets; that is, the good results in that condition can almost be observed from day to day by means of the x-ray, if you remember the work of Howland at Baltimore.

I think the subject is, of course, in the experimental stage and that it really should be attacked in a lying-in hospital with the proper chemical facilities. Not only the calcium and phosphorus content of the blood, but the intake and output in the urine and feces over rather long periods should be determined.

William H. Leak, D. D. S. The speaker's interest in the subject Dr. Rowley has so directly and well presented to us tonight is that of one who has spent years in efforts to prevent disease of the by far most prevalent of all diseased organs,—the mouth. So common, almost universally so, are diseased mouth conditions that most people—and I regret to say the large majority of the medical and dental professions also—have come to look upon them as matters of fact and of no serious consequence, except for unpleasant interruptions of discomfort or pain. This is manifested most remarkably in the essayist's paper, when he cites to us a meager handful of experiences on our subject of tonight, of a few English writers and not being able to mention similar efforts of men in this country aside from his own practice. This is, I am sure, not because of his own limitations (for, indeed, he seems to be giving us the lead), but because of the lack of available material.

Does it not make us blush with shame to have the essayist state that mention of dental care during pregnancy is found in all text-books, but ends there? Our own New York State Department of Health issues a splendid bulletin on "Prenatal Care," in which similar mention is made, and then sets down ten rules to be followed and omits the care of the mouth. The reason for this blank is that our hospitals are not giving the dental care and attention which they should and that no definite methods of procedure have been developed.

The same group of English writers to whom Dr. Rowley refers has given us a lead on the necessity of dental consultation for babies. Dr. Wallis and Waller especially. Dr. Waller has demonstrated in nearly 200 cases gains in the weight of infants after the extraction of septic maternal teeth. Then as we review the status of dentistry in England where drug clerks are still practicing dentistry, we cannot believe that the English lead is due to superior knowledge or ability, but to cooperation.

Dr. Charles Mayo, with whom our essayist of the evening is associated, has said: "It is evident that the next great step in medical progress, in the line of preventive medicine should be made by dentists." Dr. Mayo doubtless expressed a broader vision in that remark than the most of us perceived at the time it was stated, when we associated it with focal infections of the teeth. A truer fact in medicine, I believe, was never stated, and as the dental profession develops, we find today many aspects in which good dentistry, not repair dentistry, aids greatly the general health. An embarrassment exists, however, in the rightful modesty of the dental profession. In the past, the institutions for the treatment of the sick have been largely controlled, and rightly so, by the medical profession. The liberal attitude of the medical profession will freely solicit the cooperation in these institutions of the dental profession when they appreciate the valuable contributions which dentistry may offer. The response of the dental profession will not, I trust, be disappointing to our medical confreres. To date there are so few hospitals where dental consultation is available that they are negligible in number.

It has never been possible for me to get away from the phrase of the dean of my college: "First remove the cause." As I have traveled, step by step, in the study and practice of oral hygiene, I have found myself going backward from reparative work for children, to the same for smaller children, then to educational methods for children, to the care of babies and today the care of pregnant women. In this movement backward I have not lost sight of the immense value of education to school children.

Good teeth are dependent upon not only proper cleansing, correct foods and thorough mastication, but also and fundamentally upon the tissues which compose the teeth.

I shall not occupy your time in a discussion of the embryology and histology of tooth structure, but shall briefly remind you that the dental organs of the deciduous teeth and the first molars of the permanent set start their growth and development in uterine life. Also the enamel of these teeth is virtually formed during uterine life, and that the enamel when once formed, becomes a dead tissue and does not change in later life in its nature, except by decay, wear or accident. Since the enamel forms the investing membrane of all the normally exposed portions of the teeth, and that decay, to take place, must penetrate this tissue, it becomes apparent that to build this tissue well is setting up the first prevention to decay. This brings us, then, to the consideration of the child-bearing woman.

Doubtless the hospital of which you are alumni, and other hospitals for the care of pregnant women, feel that they are doing all that is possible for the good of the general health of their patients. Unless, however, they exercise dental treatment to render the mouths of their patients sanitary and serviceable, infections, leading to and contributing largely to toxemias, are likely to occur and to continue. If the toxemias may be abated by change of diet and processes of stimulating elimination, it is dealing with a direct infection in a compromising way. It should be attacked directly and, if possible, the cause of the infection removed. It is no exaggeration to say of women of the child-bearing age, of the class which regularly visit dentists, that 50 per cent. have one or more non-vital teeth, many of which are in active abscessed conditions, and that a large percentage is also suffering from diseased gums, either of which, or both, may be keeping a large army of leukocytes busy almost to the point of breaking through their resistance. If this is true of those who visit dentists, the mouths of those who do not visit dentists must be far worse and more deplorable.

Dental infections are not limited to non-vital teeth, but may also occur in the gum and alveolar tissues. These infections poison the body, both through the blood-stream and by the alimentary tract. In the early stages of pregnancy, prior to the formation of the placenta, and again in the later stages of pregnancy, toxemias most frequently appear. In these cases it would be interesting to know what proportion may be nursing infected mouth conditions. As a dental practitioner I have been impressed with the frequency with which pregnant women suffer from abscessed teeth, accompanied by the formation of pus, swelling and pain, and also of the rapid development of pyorrheal affections. It may be that the toxemias of pregnancy, and which are, by far, the greatest cause of death during pregnancy, are in no way augmented by dental infections. It is my belief that while the dental infections are probably not the initiating cause of toxemia, the constant absorption of infection from the dental organs is just one other factor lowering the immunization of the patient, and which may be just enough to throw the balance to the unfavorable side. Until we have seen proper dental care administered to large numbers of women during gestation and statistics are carefully tabulated, I shall continue to believe that the dental infections have decidedly unfavorable reaction on the patients. And it is my impression that when the cases are tabulated, I shall be the more firm in my conviction.

The inability of the patient to properly masticate, due either to loss of teeth, or to pain, or discomfort accompanying mastication, affects the quantity and the quality of the saliva, resulting in improper digestion and faulty assimilation.

Neuralgias, nervous reflexes, nervous irritations, unsanitary conditions of the mouth, and worry or fear of discomfort, or pain from the teeth or gums all react seriously upon women during pregnancy.

The presence of the dental disorders are, to say the least, in most cases inexcusable. They should be eradicated in all cases where proper care is supposed to be extended. This would be but another step towards the natural and normal contributing to health and happiness, not for one life, but for the health, contentment and happiness of two lives.

As before stated, after the formation of the enamel, it undergoes no physiological changes. Therefore, while the dentine may suffer structural changes, this is not true of the enamel. Since decay of the teeth starts from the exterior, it must be that if decay takes place more frequently in pregnancy, that it is because of changed mouth conditions. During gestation the saliva is frequently acid. The stomach secretions are much increased in acidity. Vomiting occurs, rendering the mouth sour and acid. The mouth may not receive proper cleansing normally, and certainly not better care during pregnancy. These are the influences which cause a greater frequency of decay. Once the enamel is penetrated, decay takes place more rapidly because of possible constitutional changes in the dentine and of the hyperacidity present.

Rapid development of intensity of pyorrhea in pregnancy is indicative of the inability of the white blood corpuscles to respond as well as normally.

As on all other matters of hygiene, dental prophylaxis should be more carefully practiced during pregnancy. The teeth are of too great a value to be considered lightly. The expectant mother should visit the dentist at least every two months for prophylactic treatment and intensify her own personal care.

Early in pregnancy, every women should have her mouth placed in as good a hygienic and serviceable condition as possible. This means the removal or most careful treatment of abscessed teeth and pyorrhea pockets. It is much better to definitely remove these infections than to allow them to remain and be the possible cause of serious trouble by systemic infections, or of causing severe pain late in pregnancy and at a critical period. Danger from carefully performed dental operations is so remote that it is hardly worth consideration, excepting that the dentist should be informed of the patient's pregnancy.

DR. JOHN O. POLAK. We are all doing prenatal work more or less perfectly and imperfectly, and this question of the care of the teeth during pregnancy is a very serious matter.

I had rather felt until I heard Dr. Bauman speak, that the teeth had some etiological relation to some of the toxemias in the early months of pregnancy. From what he says now I would be rather impressed perhaps with the belief that it is the acidosis of the vomiting that had the effect on the teeth, yet we all know that during the early months of pregnancy and also in the later trimester, the last trimester, that the affections of the teeth are more prominent than they are in the midtrimester.

The fact that the baby requires a certain amount of calcium for its construction, whether we know the biochemistry or not, is without question the basic proposition, to my mind.

The care of the teeth during pregnancy as a prenatal proposition is most important.

While I am not quite in accord with some of the men who trace all focal infections to the teeth, yet I do believe that there is a certain number of them that can be traced to the teeth, and from the work which has been done at Rochester they have made an attempt to show us that there are certain definite focal lesions that give rise to conditions in the woman that are serious and have an influence in pregnancy.

The doctor's cases are rather too few to make positive deductions. He has cited several that are interesting because of the effect that dentistry has had on these cases.

It has been our practice to follow out very much the same line that the doctor has pursued, though not perhaps as well. His paper has given us a stimulus to do a little bit better, and, for that matter, I feel that in the future it would be a good plan to not only use our x-ray where there is a definite dental lesion, where the patient is complaining of dental conditions, where we find evidences of that, but as a routine, just as we have found that blood chemistry, unless done routinely and systematically, just as we have found that the Wasserman reaction, unless it is done routinely and systematically, is of very little value unless we do it as a routine, because only by extending it and making it a routine procedure in our prenatal care is there any possibility of making deductions that are of any value in the large majority of instance. As an example, when at first we were doing the Wasserman only on cases of suspected syphilis we were amazed at the very, very small number of positive results that we were getting and yet on doing the Wasserman reaction on every pregnant woman we found that the incidence of syphilis was rather more marked than we had supposed from our incidental investigation. The same thing is true in the study of the blood chemistry. While blood chemistry at the present time has not given us what we expected in our deductions, in our toxemias, and has not supplied us with what the clinical work has already supplied us with in the majority of instances, yet we believe in carrying it out over a large series of cases that we will be able to make some definite deductions, and that is the same position that we must take in this contribution that the doctor has made here; that is, more routine attention to the teeth of the pregnant woman.

There is no question that there is every once in a while an unexplained hematogenous infection, and one can reasonably suppose that some of these hematogenous infections may come from the streptococcus. Although it may not be the hemolytic variety in the cases that have been examined, yet the streptococcus is peculiar: an innocent streptococcus can sometimes change its character, and it does give us very definite signs at certain times.

Personally, we all feel exactly as the doctor does in his conclusions, namely, that the teeth need examination, that the teeth need x-ray examinations, that pulling a tooth or pulling teeth during pregnancy will not produce an abortion. Those, I think, are practically the only points that we can make. It is a subject that none of us have any definite information on except the general impressions that we have, and it simply adds another thing to what we should do in prenatal work.

MR. JOHN C. GEBHARDT, of the Association for Improving the Condition of the Poor. I am very glad of the opportunity of coming here and listening to the valuable discussion and to the valuable paper which preceded it, because it is a question which is very much before us in the Association for Improving the Condition of the Poor, an organization which is more commonly known as the A. I. C. P.

The A. I. C. P. has been doing a great deal in the prenatal field through its nursing service. We have at the present time about 40 nurses engaged in doing educational nursing work. The number of families receiving care at the hands of the A. I. C. P. in any given year would probably amount to about 5,000. According to our last year's report, the exact number was 5,886 families, these representing those under the care of the organization, and of these 4,241, according to the last report, received nursing care.

There are two restricted areas where we are trying to carry out an intensive health administration, paying particular attention to the proper prenatal care of the pregnant women in those districts. Throughout the city about 3,500 children of preschool age are given intensive care by our nurses. In any given year about 1,500 women receive educational nursing care during pregnancy at the hands of our nurses.

We have selected an area on the lower East Side, from Houston Street to Canal Street, and from the Bowery to Broadway, in which there are about 33,000 Italians. In that district we have 16 nurses, 2 physicians on part time, 4 dentists, one of whom is on full time, and 3 dental hygienists. During the past year we looked after about 600 mothers in that district during their prenatal period, and have extended this service to about one-half of all the births in that district.

For about a year and a half we have been carrying out, with the cooperation of the Department of Health and the Board of Education, a dental service for the school children in that district, particularly those in the first five grades.

During the summer months and during the vacation period we look after as many of the preschool children as present a definite need of dental care.

Quite recently we have become very much interested in providing some dental care for the pregnant mother. We believe that dental care for the preschool child and for the pregnant woman is practically an untouched field and believe that if preventive work is to be done, it must be in that particular field. I am speaking merely as a layman. None of us has been quite sure whether we would have the support of the medical or dental profession if we did try to do any extensive dental work in pregnant women, but we do hope during the coming year to select perhaps 25 or 30 of the most intelligent mothers in this Italian district and keep them under the care of our dentists during pregnancy, seeing to it that they are properly instructed in the care of the teeth, not only in the care of their own teeth, but also the teeth of their children, in order to produce a proper amount of activity on the part of the children they are rearing in this very important subject of the care of the teeth. It is a question in which we are very much interested and in which we hope to make a beginning in the next few months.

We have two prenatal clinics a week. It has been very difficult to get the mothers to come to these clinics during pregnancy for observation and treatment. The Italian mothers, as perhaps many of you know much better than I do, are more or less averse to submitting to a physical examination by a medical man. When we went into that district 90 per cent. of the babies were delivered by midwives. During the last year we have been able to get a good many more mothers delivered through the Outpatient Department of the Lying-In Hospital than when we first went into the district. We have long-standing tradition and superstitions to deal with. Gradually, however, we are getting proper standards developed. The most hopeful groups are the young mothers. We hope this year, with the advice of the medical man and the dentist, to be able to do something worth while with the pregnant women in this particular district.

Dr. W. A. Rowley, (Closing). One of the points that were brought out by almost every one who discussed the matter was the matter of full mouth rays. I didn't state that we did that routinely because in the series of case reports, before this series was completed, only a small selected number before them were recorded, and all of the patients were not given a routine ray. However, in the last few months all the patients, whether we could see anything in the mouth to indicate a ray, had a ray done.

With regard to oral and dental sepsis: There are a good many of our patients out there who are young girls of very healthy families and a good many of the country people who have most excellent mouths of teeth without a sign of a cavity or without a sign of any decay, or any condition in the gums that would even make you suspect that they had anything wrong with the mouth, and the opinion as to whether a ray was necessary or not was made in cooperation with the dentist.

With regard to the type of organism that has been found in periapical infections: Dr. Gardiner's communication to me is the one on which I based my statement, and if I remember accurately, he said it was about 4 per cent. of the cultures from teeth which showed the hemolytic type, and the rest of them showed the viridans, so that very few of them had the hemolytic type.

Dr. Polak, in his usual kind way, brought out some points that are very interesting, and if I have accomplished no more by presenting this little preliminary report, as it might be called, to you than to stimulate the very thing that Dr. Polak spoke of, namely, the carrying on of further work by the people who have an opportunity of seeing more cases than we do out there and who are in position to handle large numbers of these cases and accumulating a large amount of data, something which is so very essential before we can make any definite statements, then I am well satisfied.

None of the results following the removal of teeth have been startling. There has been nothing brilliant about any of it, and possibly we have removed some teeth when they might just as well have been left in. At least from the way patients who had teeth pulled went on through with their labors and the way some of the patients acted who refused to have teeth pulled and went on with their labors, probably it would have been just as well if we hadn't pulled the teeth. But we always felt a little bit better if patients with apical abscesses had them out because if there were puerperal infection or any condition developed, we would feel better off by knowing that affected teeth had been removed.

I might add that we have also removed the tonsils in pregnant women, but I said nothing of this in the paper. We have a small series of this type of case. I believe that all these factors play a part in preventing the development of foci of infection.

I think the work which has been done in this district along hygienic lines is of the very finest. In a very small way we are trying to start the same thing, but we are working in a small town where it is hard to make people realize that pregnancy is anything but just an ordinary part of a days' work.

MEETING OF FEBRUARY 15, 1922.

DR. IRVING W. POTTER of Buffalo, presented by invitation, a report on his METHOD OF PERFORMING INTERNAL PODALIC VERSION, illustrated with a lantern slide demonstration.

DISCUSSION.

DR. GEORGE L. BRODHEAD. Those of us who have been fortunate enough to have seen Dr. Potter do the marvelous work that he has done, cannot but wish that we could do the work one-half as well as he does it. About a year ago it was my good fortune to go to Buffalo and see him operate. I saw him do five versions in one day, he had two others that I did not see, his assistants had two more, making nine for the day, which is a fairly good record. I came back from Buffalo very firmly convinced that version done in the way Dr. Potter told us to do it was a thing to be tried out and I straightway tried out a series of 25 cases at the Harlem

Hospital. In all of the multiparae we came out very nicely. I think in five of the nine primiparae, we lost the baby and in the fifth case I got hold of the feet and got them down into the pelvis, and inasmuch as the feet and head both occupied the brim of the pelvis at the same time, I could make no further progress and had to leave the case to nature. Ultimately, the patient delivered herself normally by the vertex presentation, which was very fortunate for me.

In this series of 1130 cases he must have had a good many consultations and to have no maternal mortality and to have a fetal mortality of only 2.3 per cent. is marvelous, to my mind. I think we can safely conclude that these figures are the result only of long years of experience. If we could learn the results possibly of Dr. Potter's first thousand cases of version I dare say here the results would be very different.

Now, aside from our very brief experience with version as Dr. Potter does it,—and our version probably was not done as Dr. Potter does it, but we tried to do it that way,—we cannot discuss his version, but it occurred to me that possibly it would be interesting to look over my last thousand consecutive cases which I have had myself. There were no consultations in this series and all were women I picked out, only women who were seven months or over, and I thought that perhaps it would be interesting to compare a thousand consecutive cases delivered by the routine methods as we know them, in this series, which include only private cases, which I have been able to watch from first to last.

In this series there were 504 multiparae and 496 primiparae, nearly the same number of multiparae as primiparae. Nine hundred and thirty nine patients were 8½ months or at term; the rest varied from 8½ down to 7 months. Among the 1000 cases 50 per cent. were delivered normally; 37.6 per cent. were delivered with low forceps; and there were 35 breech cases. In the primparae I found I used low forceps in 54 per cent. of cases and in 21 per cent of multiparae, making an average of about 37½ per cent. of multiparae and primiparae.

Now, then, 50 per cent. of these cases were terminated normally, 88 per cent. were either normal vertex cases or terminated by low forceps operation, and 91 per cent. were either normal vertex or breech cases or. were terminated by low forceps. In other words, 91 per cent. of these cases were either normal, breech or low forceps.

Version was done 23 times for head floating above the brim (7), transposed and prolapsed cord (1), prolapsed cord (5), transverse presentation (2), failure of forceps (5) and placenta praevia (3).

The number of cesarean sections, I find, in the 1000 cases during the time that these 1000 patients were delivered, was only 45.

I dare say that in a good many of these cases I would have been very much better off had I resorted to cesarean section. Possibly cesarean section was not done as often in our series as it should have been. Inasmuch as Dr. Potter has done twice as many cesarean sections, it makes a good deal of difference.

Of lacerations of the perineum (which is not under discussion here, but which I thought might prove interesting) there were 194 in this series, or nearly 20 per cent morbidity. Perineorrhaphy, either median perineorrhaphy or episiotomy, was performed in 97 cases, or nearly 10 per cent.

Of the 1000 babies, 960 were born alive and lived fully two weeks, 960, or 90 per cent. living, a fetal mortality of about 4 per cent.

Now, in this series of deaths I will read over a few of them to show you how impossible it was to obtain a good result in these cases, simply to account for some of this 4 per cent. mortality:

1 baby, 7 months.

1 baby, 7 months, placenta previa, podalic version, 3 lbs., lived 3 days.

1 baby, 7 months, accidental hemorrhage; still born.

1 baby, 7 months, lived 24 hours.

1 baby, 7 months, placenta praevia.

1 baby, 7½ months, accidental hemorrhage.

1 baby, 7½ months, toxemia, induction, 3½ lbs., stillborn.

1 baby, 8 months (?), twins, 3 1/16 lbs.

1 baby, 7½ months, acute nephritis, induction, face, stillborn.

1 baby, 8 months, 4 3/16 lbs., lived one week.

1 baby, 8 months, eclampsia, version, 5¾ lbs., lived one day.

1 baby, 8 months, (2 previous stillbirths), induction; normal labor; stillbirth, and so on down the list to a case of hydrocephalus, spina bifida, etc.

So I feel that of the 45 babies fully 30 could be very easily accounted for and the deaths in no way attributable to the method or operation. I feel that any method or operation in these cases would have resulted in the same mortality. That leaves us 15 babies which shows a mortality of 1.5 per cent.

These cases haven't been picked out. They are consecutive cases as nearly as I could make them, and I feel that these babies which should be subtracted, because in no way could they have been saved, in our opinion, would give us a mortality of 1.5 per cent. To be conservative, we can add on another 1 per cent. and equal Dr. Potter's figures.

When you consider that a good many of these patients had no anesthetic, a large number were delivered with forceps and a good number delivered normally, it seems to me that certain conclusions can be drawn. We are willing to concede that the patient in many instances may be spared an hour or more of second stage pain and the time of the accoucheur be conserved as well. It may be true also that, owing to the short second stage, uterine inertia and postpartum hemorrhage may be less frequent.

In our hands, in spite of careful ironing out of the vagina and perineum, in cases of version, laceration has not been infrequent. In Dr. Potter's hands his method of version appears to give wonderful results, far better, in our opinion, than the average man could possibly obtain, owing to lack of training, opportunity for frequent performance of version, lack of hospital facilities, etc. When, as we have shown, labor is normal, or can be terminated by the simple low forceps operation in 91 per cent. of our cases, and when the fetal mortality is as low as we have obtained, we believe that present methods of delivery should be continued, with our personal belief in the early use of the low forceps operation when the head is low in the pelvis and advance is slow.

Dr. Piper (Philadelphia): At the University Hospital (Philadelphia) and in other places I have tried version. I don't think there is much question that in the hands of Dr. Potter probably version would be as successful as any other method of procedure. The question comes up merely in my mind whether it is correct, that we should teach students that this is an elective procedure.

I believe myself that Dr. Potter has served a mission in the advance of obstetrics, in that he has brought back to us an old obstetrical operation of choice and that he has taught us a better way to do it than any one that has ever done it before.

I must agree with the preceding speaker that I am not converted that it is an elective procedure to be used in all cases. I have done versions. The pictures of the twin case reminded me of one that I did as an elective case, in which the patient had an exophthalmic goitre and was 7½ months' pregnant. In that case we allowed her to stay in labor for two hours. I did a double version in that case with two living children, after complete effacement and partial dilatation.

I have tried to do Dr. Potter's version, not successfully, I am sorry to say. I don't blame that much as on the method as I do on myself. I think we have a right to consider the use of version as an elective procedure. That is a personal opinion. I think we have a right to consider t in posterior occiput presentation in preference to forceps delivery with the Scanzoni maneuver with rotation. There are other conditions in which when you are up against the problem of whether you should use high forceps or version I should use version. As to doing it routinely, as I said before, I am not convinced as yet.

Dr. John O. Polak. It is always a rare privilege to listen to Dr. Potter, he is so absolutely frank, he is so absolutely honest, and he is so absolutely confident of his ability to do this operation.

I made two short trips to Buffalo and saw him do his work, and I have learned from him what version should be and have been impressed with the detail of his technic, and I came home and worked it out day after day on the manikin until I think I can do it. I have done it on patients where version, in my opinion, was necessary, and I want to say to him that of all the obstetric teaching I have received, the detail and technic that I have acquired from watching him and coming back and trying out what he has done, has been most valuable.

Now, he brings up the question of version and he discusses it, as I understand it, as the technic of version. If we are going to confine ourselves to that, I would say that there is no use of discussing the doctor's paper, it is perfect; but if we are going to take up a study of the doctor's last 1130 cases and consider that he, who is, without question, not only the peer, but the superior of any man in version in this world today, as I look at it, can get away with a fetal mortality like this, I say "Go ahead, go up to Potter and have the baby delivered." But just consider for a moment the fact that one in every eleven women has a cesarean section.

Now, I have great regard for his opinion and for his knowledge of the pelvis, but I have studied something like 10,000 pelves and I cannot find an indication, even if you take all the eclamptics and placenta previas and the others, for doing a cesarean section in 1 in 11 cases. He gets no mortality. It is remarkable. I know why he does it. I have seen him operate. His technic in his cesarean sections is as clean and as perfect as his technic in versions. But I have also taken and studied 2,200 cases from operators, no less operators than the late Dr. Cragin, Barton Cooke Hirst, A. B. Davis, a few of the Brooklyn operators, including Humpstone and Beach, and E. P. Davis, of Philadelphia, and Peterson, of Ann Arbor, making up all told a total of 2200 cases that we were able to get, and there was a mortality and a morbidity which was perfectly surprising in the perfectly clean cases done before labor. There was only 3 per cent. mortality. Potter gets none. It just shows how well he can select his cases.

Taking his last series of 1,113, every seventh woman of the 14 women that went to Buffalo, one out of 14 had a cesarean section and one woman lost her baby. If you analyze the last report before this, you will find he had a foetal mortality that was higher.

His previous estimate was 6.7 per cent. Now he comes down to 0.2 per cent., which is perfectly wonderful. It just shows you how much better he has chosen than he did last year.

But the next point is in regard to indications. Now, I have heard him read this paper four times, or a paper similar to this four times. He has always started in to give me indications for version, and it has simmered down to this one thing—relieve the woman of second stage pains. I can relieve the woman of second stage pains, but I don't know how to carry her along enough to get to the second stage sometimes. I want him to tell me that, how he is going to get dilatation and effacement in some of these cases.

Furthermore, I cannot see why any woman who is competent to dilate her cervix fully and drive a head to the spines should have that head displaced in order to do a version, when we know that when you do enter the birth canal, except in Buffalo, there is some chance of infection.

Now, gentlemen, the real point is this: it is granted that this procedure that Dr. Potter is teaching is in his hands as nearly perfect as obstetrics can be. It is granted that he can deliver 1,130 women, 100 by caesarean section,—one in every 11,— and 938 by version, and only lose, including the babies that died within the first fourteen days, 22 babies. I am frank to say that that is just an expert's report on something that he is perfectly facile in. In the ordinary clinic, with more than Dr. Potter doing it, it could not be done, and he knows it as well as I do. For the general practitioner, or the practitioner to start off and do it, it cannot be done, and the question is not that his principle is not the most perfect, but it is a question of just where we shall stop for the indications for version.

It is the same old story as with the caesarean section. Last year while in Swampscott, Dr. Chipman said to me, "Have you noticed a higher morbidity and mortality in caesarean section than in straight abdominal section?" I said, "Yes." He said to me, "Would you mind working this thing up?" and we were surprised to find that there was a morbidity and a mortality very much higher than that attending hysterectomies, even in perfectly clean abdominal sections. Now, why is that so? It is because we are dealing with different structures. We are dealing with a birth canal, with a wound in it, and just about the fourth, fifth or sixth day the organisms migrate and we have a wound infection of the uterine wound or some type of infection of the lower uterine segment, and as a result, we get a higher morbidity.

In closing, I want to thank Dr. Potter again for what he has taught us, and I want to call your attention to this point, that the whole question of version as he puts it represents the results attained by an expert. It is not a matter to be taught in medical schools or teaching hospitals where many men have got to do it. One man alone cannot do it. It takes work, it takes sacrifice of life. The question is, is it worth it?

Dr. Tracy, (Philadelphia, Pa.) I have enjoyed Dr. Potter's paper, and whether we do or do not agree with him in his indications for version, I think we all acknowledge that he has taught the profession how to do a podalic version.

About a year and a half ago I had the privilege of spending two days with Dr. Potter in Buffalo. If you want to see him work, you should go to Buffalo. I saw him do two caesarean cases, and, as Dr. Polak has said, his technic was beautiful. I told him I would like to see his charts. He showed us at least twenty-five private patients, and showed us the records in every case. One patient had a temperature of 102.5°F. for one day, another had a temperature of 99° one day. With those two exceptions, the temperatures was normal.

His patients were more than enthusiastic, and I think they would all go back to have another version. In fact, I saw one patient in her tenth delivery. I asked Dr. Potter how many versions she had had and he said that he delivered her ten times by podalic version.

Another thing I want to touch upon is the condition of the birth canal after his deliveries. The following day I saw him deliver 6 cases. I asked him to expose the vaginal canal. He did so and I found he hadn't a break in the mucous membrane in the first one he showed me. In the other 5 cases he showed me the birth canal and there was not a break in the mucous membrane in any one of the cases, and I think 4 of the 5 cases were primiparae.

One of my friends in Philadelphia said to me two or three times, "Potter will not be doing version five years from now." After talking with his patients and noting how very enthusiastic they were, I am convinced that Dr. Potter will have all the obstetrical work he prefers to do as long as he wants to practice obstetrics.

With regard to the question of caesarean section versus version, I would say that, personally, if I were a woman, I would prefer caesarean section to version. I know because I have had an abdominal operation myself. If I were a woman, I would elect caesarean section for delivery.

Dr. George G. Ward. Like the rest of the gentlemen who have spoken to you this evening, I have had the great pleasure of going to Buffalo and seeing Dr. Potter work at home, as well as seeing him work away from home. I can verify what Dr. Tracy has said about the way in which Dr. Potter treated him for he did the same for me as he did for Dr. Tracy. He took me around and showed me charts of the cases at the Lying-In, and the statement made by Dr. Tracy relative to the question of the morbidity of these cases I can positively bear him out in.

The interest in Dr. Potter's work is, of course, very great, and when he came on to New York here not very long ago we were glad of the opportunity to have him demonstrate his method at the Woman's Hospital, and I arranged with the Obstetrical Division to provide material for Dr. Potter in order that he might show those of us who were interested in his work the technic of his method. We gave him three cases to do, one of which was quite a difficult one, a primipara. In that case the child was not a very large one (about 6 pounds, 6 ounces) and was a stillbirth. It was an unusually difficult case, and Dr. Potter, I know, remembers the experience.

It seemed to me that it might be of interest to look over our records and see how many times version is being done in what I might speak of as a conservative service at the Woman's Hospital, and, so, I have taken the last 1,000 cases, have had the records looked up, and we find that in those 1,000 cases 15 versions were done, which gives a percentage of 1.5. These are cases in the ward service. They have nothing to do with private cases at all. The period covered by this particular series extends from October 1, 1919, to December 7, 1921, a total of 26 months, during which time we did version 15 times, or 1.5 per cent. However, three of these cases were done by Dr. Potter for the purpose of demonstration when he was here October 22, 1920. None of these three had other conditions necessitating a version, so if it had not been for his clinic, there would have been but 12 versions in 1,000 cases, or 1.2 per cent.

All these versions were internal podalic by the bimanual method, using one hand in the uterus and one externally. Thirteen were complete versions and two partial (in transverse presentations). All were done after the cervix was fully dilated. All mothers were discharged in good condition.

An analysis of these 15 versions shows: Primipara 6, multipara 9, at term 12, 8½ months 1, 8 months 2, spontaneous labor 8, induced (bag) 7, normal pelvis 14, deformed pelvis, flat 1.

Of those induced, 3 were for Dr. Potter's clinic. It should be noted that all of the 3 cases that Dr. Potter had were cases that had induction of labor by bags and that they were not cases that were perhaps ideal from his standpoint, as they were precipitate. Part of the labor was induced before they went into labor normally.

Now, as to the weights: Babies weighing 9 lbs. or over 2, 8-9 lbs. 4, 7-8 lbs. 4, 6-7 lbs. 1, 5-6 lbs. 3, 4-5 lbs. 1.

Indications: Placenta previa 4, persistent O. P. 4, Dr. Potter's clinic 3, eclampsia and toxemia 1, brow with chin posterior 1, second baby of twins 1.

Asphyxia in baby, without 8, livida, moderate 3, pallida, marked 1, stillbirth 3.

Three cases of asphyxia of livida moderate.

1—Prolapsed cord—partial placenta praevia—cord replaced without difficulty. No asphyxia.

Hemorrhage.

2—First degree—case of eclampsia.

13—Second degree—placenta praevia.

14—Placenta praevia—third degree.

Foetal mortality—4 in 15, 26.6 per cent. (3 stillbirths, 1 death).

Foetal morbidity—4 in 15, 26.6 per cent. (3 asphyxia livida, moderate; 1 asphyxia pallida, marked).

The foetal mortality, then, 4 in 15, makes a very high mortality, 26.6 per cent.

The points that we come to are that version is perhaps not done very often. If you exclude the three cases of Dr. Potter in the 1,000 cases, we might say that that represents a conservative service. Dr. Potter, we might say, represents the other extreme, or a radical treatment of these cases in doing version to the extent that he does.

It seems to me that there are several lessons which we can learn from Dr. Potter. One is, of course, the technic. It must be seen to be appreciated. Once seen, you must admire it and realize that we have something to aim at to obtain the facility and the skill which he employs in doing his operation.

One of the points that he brings out that is very valuable in the technic, is his teaching to prepare the passages for the passenger to come through; his ironing out of the pelvic floor, the fact that he takes so much time in preparing the parts, the fact that he is so deliberate in the delivery of the child at the time of expulsion, are all valuable points. We can profit by them without question.

The other point that comes up perhaps is the one of whether or not in a conservative service we do version sufficiently often. It seems a more preferable operation than a high forceps. We would rather attempt version, I think, today than high forceps as being a very much safer procedure.

The other point is that if Dr. Potter goes to one extreme and we in a conservative way go to the other extreme, perhaps the pendulum should swing more to the midline and we should use version much more frequently than we do as a life-saving measure for the mother and perhaps for the child. The fact that Dr. Potter can do this work with his marvelous results in no way, I believe, justifies us as teachers of obstetrics to exploit his method as the routine or proper way for the man who is being taught obstetrics, and that he must follow such a procedure. I think it would be extremely dangerous. It is not a safe procedure for the man who is not expert to do this work, and I cannot agree that it is a safe method to teach on that account.

It has always seemed to me interesting if we could only see the ultimate results of the doctor's cases in the follow-up clinic. That is perhaps not possible because his cases are largely private cases, and to classify them as we do in our ward cases in the hospitals and follow-up clinics is proably not possible to do; but it would be very valuable if we could draw a comparison between his large number of cases of version and those delivered in the ordinary way, as to temperature, injury to soft parts, etc. We hear, of course, that he has very few injuries. It would be very interesting to learn if there is much less gynecology as a result of his work in Buffalo than there is here where the cases are not delivered by version.

I wish to express my appreciation of what I have learned from Dr. Potter, but, at the same time, I must take the position that Dr. Polak and Dr. Brodhead and the others have taken that we cannot teach our students this extreme principle of employing version in the great percentage of cases as a routine as he does.

DR. JAMES A. HARRAR. I think Dr. Potter should be very much congratulated on the wonderful figures that he has come down from Buffalo with this evening,—2.3 per cent., which includes macerated foetuses and monsters. It is much better than we can do delivering them as we do at the Lying-In. Our foetal mortality there runs about 3.25 per cent., including deaths of babies, stillbirths, monsters and everything.

Dr. Potter has assembled a number of small maneuvers into one big maneuver which we call by the name of Potter version. The majority of these maneuvers are not new. He showed three or four things which were new and most interesting—First, the extreme slowness with which he delivers the baby; second, the bringing of the breech into the hollow of the sacrum in a natural sitting position; third, the delivery of the shoulders anteriorly without much attention to the arms themselves; and, fourth, the absence of any pressure on the abdomen after the baby is turned. I might say, parenthetically, that the hand which he showed in the picture pressing up the head, was outside of the abdomen, not inside, as it looked in the picture.

A good many of us at the Lying-In have tried version, following these various maneuvers, and we believe that each step in version done in the Potter way is the easier way to do it.

I think in criticising Dr. Potter's work we must separate his technic from his indications. We cannot say that Potter version is wrong in that way. Anybody seeing him work must realize that whenever we do version we must make it a Potter version. I also think we should do less high forceps and less median forceps, substituting a version for them. We are not prepared, I think, to substitute version for low forceps or for spontaneous delivery.

Dr. Irving W. Potter. (Closing). I realized when I came down here that I had nothing very startling to tell you. I do not see anything very much out of the way about a man's delivering 1,100 babies a year, and I do not see anything very much out of the way about a man's doing 900 versions in a year, and I see less to have any internal disturbance about if a man does 100 abdominal caesarean sections a year. Here is Dr. Brodhead, who comes along a pretty close second with 45 caesareans. I expect that in the course of time Dr. Polak will come along with about 60 or 75. I don't think he is ever going to catch me because I have the start on him.

There was a time a few years ago when nobody did version. I remember the first paper I read on version. It was received in such a way that you would have thought that war was declared by everybody on everybody else. Everybody seemed mad. It was said that I would not aveh enough business at the end of two years to live. All of my business was going to smash. I would be run out of town. Well, I have lived 53 years in Buffalo, practiced medicine for over 30 years and have patients in every hospital in Buffalo, except the City Hospital, which is a public institution. I have been connected with a Catholic institution through three or four administrations and am not a Catholic. I have just as many enemies as any other man has that does any work. Any man who does no business has no enemies. I am not a good fellow all around, but I have helped a lot of men out of trouble by doing a version after they had tried forceps and everything else on the case.

I am not a teacher. You know perfectly well that I could not be a teacher. We have only one medical school in Buffalo and that is tied up like a purse and nobody can get in. I couldn't get in there and I don't want to get in.

Dr. Polak once said I was a demonstrator. Well, I would rather be a good demonstrator than anything else. I don't think that these teachers of obstetrics want to teach this, because, so far as I am able to find out, they don't know how to do it themselves. Now, there is nothing personal about that remark. They admit it. When they do only 15 versions in 1,000 cases, they don't know how to do version. That is understood. They cannot teach it, and I don't think they should teach it.

I want to tell you this in all seriousness, that any man who is qualified to do obstetrics ought to be able to do a version, just the same as any man who qualifies as an obstetrician, should be able to do caesarean section. I don't think that every fellow, as soon as he gets a diploma, should go out and stick his hand into every uterus he sees. I never said so. I have a boy myself who is studying medicine and when he gets out I don't want him to go out and do it either. I will want him to go around to see how the other fellows do it.

Now, somebody told me tonight that medicine was a very delightful profession, because while we didn't always agree with each other, we could always be friends, and I am delighted to know that I have so many friends here.

The birth is not bothersome in Buffalo. There is nothing to do in the first stage of labor: let them alone. If I played golf, that is when I would play golf, during the first stage of labor. Just as soon as that was over I would come in from the golf course and deliver my patients. They don't have much suffering in the first stage of labor, as far as I can learn. It is when the head is ready to go over the cervix that they have pain. Occasionally we have a multipara or a primipara who is fussy and nervous and creates a little disturbance. In all such cases I give a hypodermic of morphine.

As far as high forceps are concerned, I would say that I don't know anybody who uses them. I have only a short forceps in my possession. I have several pairs of those scattered around Buffalo so that I can have them when I want them.

Now, another thing: I never owned a bag, and I wouldn't own one. If you should hand me a bag and told me to put it in a patient, I would have to send for somebody else to do it, because I don't believe in it at all.

Another thing: I have never done an episiotomy. A little further away from where I live, they do episiotomies in about 95 per cent. of primiparae. I have never done an episiotomy and I don't see any occasion for doing so if the birth canal is properly prepared.

Now, I have been accused of doing two things. One of them is version, which I got away with for a long while. Then they said I did caesarean section. That is perfectly logical. You fellows who don't believe that, do forceps. Well, go ahead and do forceps. I don't like it.

I think I have demonstrated by my method, although I don't like to call it my method, because it is not my method. It is a good deal older than any of us. I have simply brought it into prominence. I like it. I like to bring down both feet instead of one foot. I like to take my time.

It seems to me that these teachers of obstetrics should get their classes together and demonstrate this thing to them, the mechanism of footling, for instance, which, when you come to deliver the head, is entirely different from an elective version, because with a footling you have the extended head, whereas with your elective version you always maintain your flexion. Let them study the act of bringing down the feet into the world and then the knees, and then the hips, and take your time and let the buttocks come around in the hollow of the sacrum, then rotate the shoulders and deliver one shoulder into the arch, then rotate the other one and deliver it anteriorly, then flex the head from above in the pelvis and deliver it over the perineum. It seems to me that that is the way this delivery should be demonstrated. It should not be taught under a sheet with a clock on the wall and a fellow snapping his fingers every second and some body else urging him on and delivering the woman in that way. Those days are gone by. You must take time for this.

I never advocated teaching this to the undergraduate, never at all. When I began to do it, they said I did it on everybody. Well, I didn't. I do it on 95 per cent. of patients because I think it is right. But I don't think that everybody ought to go and do it. A man who is properly trained and properly taught and understand obstetrics should be able to do it, provided he hasn't a hand as big as his leg. Now, an anatomical freak should never be an obstetrician. A fellow with a long slender forearm and hand can do it very much better than a man with a beefy arm. The latter cannot do it.

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Vol. XII JANUARY, 1923. No. 3

THE FUNDAMENTAL CAUSE OF SPLANCHNOPTOSIS. ABDOMINAL INCOMPETENCE: A DEVELOPMENTAL FACTOR

II—A Study of Certain Details of the Prenatal Evolution of the Abdomen: With Special Reference to the Status at Term*

BY

AGNES C. VIETOR, M.D., F.A.C.S.,
Boston, Massachusetts.

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Introduction

THIS STUDY was made in an attempt to ascertain in the newborn the anatomic paths predisposing to (1) abdominal incompetence and (2) visceral ptosis; also, the anatomic paths favoring the evolution of (3) the retracted lower thorax; of (4) marked lumbar anterior convexity; of (5) marked forward rotation of the pelvis; and of (6) abduction (pronation) of the feet.

The clinical observations of the writer had already shown her that the above conditions are developmental deformities; that they are the result of retarded or uncompleted or reversive evolutionary processes; and that they are to some extent correlated.[1]

As the study progressed, evidence appeared to show that (7) some lateral curvatures of the spine, with and without rotation of the vertebrae; (8) some other antero-posterior curvatures of the spine; (9) flattening of the upper anterior thorax; (10) narrowing from side to side of the upper thorax and (11) elongation and narrowing (as well as other modifications) of the thoracic cage as a whole—belong in the foregoing list of correlations.

Further, light was thrown on (12) the anatomic paths favoring the development in some cases of what is commonly called "round shoulders," and on (13) the mechanics of respiration.

Report of Research Scholarship of the Society of the Lying-In Hospital, New York.

And the conclusions made from clinical observations, which have previously been published by the writer,[1] seem to be here demonstrated anatomically and experimentally, *i. e.*, that the retention of the viscera in their normal positions depends upon the development of normal competence of the abdomen; and that failures in the normal development of this abdominal competence and visceral retention are correlated with the development of the above-mentioned departures from the normal body form.

It was desired to make this study in the newborn so as to eliminate the influences of postnatal environment (which begin to modify the child as soon as it is born); and then to introduce some of the modifying factors of postnatal environment as uniformly and with as few complications as possible, and to observe the results along the paths indicated.

It was specially desired to note the so-called "congenital variations" in the individual viscera, and to see how the ptosis or displacement of such viscera varied from the ptosis or displacement of so-called "normal" viscera.

But so many variations in details were immediately met that it was seen that the terms "normal" and "congenitally defective" still remain to be interpreted, much of their present usage resulting from inexactness in observation, and consequent error in the inferences drawn from such observation.

In many cases studied, the conditions found at term in certain viscera were exactly duplicated in those of other children of a much younger age; and vice versa.

As a result of the wide variations noted, it seemed wisest tc consider the subject more broadly and, while attempting to use the child at term as a base, to study all the cases as in one, the prenatal class; hoping that as records accumulated, the subjects would group themselves along a more or less regularly progressing line.

In this prenatal class are at present included 41 children, from the fourth to the ninth months of intra-uterine life. For reference, this prenatal class is divided into sub-classes according to individual age—thus Class 4 means a four months' fetus; Class 5, a five months' fetus, and so on; Class 9 meaning a child at term, the class number always representing the intra-uterine age of the child. There have been included the records of 3 children born at term who lived for a certain period of time up to 24 hours—16, 18 and 24 hours, respectively. It was considered best to designate these children by giving them a separate class number—Class 0.

The records of these cases are not uniform because the plan of observation was only gradually worked out. Constantly attempting to restrict

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[1] Vietor, Agnes C.—I. Introduction to the study of the fundamental cause of splanchnoptosis—abdominal incompetence: a developmental factor. Proceedings of the Fifteenth International Medical Congress, Lisbon, April, 1906; Section IX, *Chirurgie*, pp. 279-304. *Boston Medical and Surgical Journal*, August 9 and 16, 1906.

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observation to the fewest factors which seemed fundamental, accessory modifying factors continually presented themselves and demanded consideration.

The laws which are shown by this study to be constantly at work modifying visceral position and mobility (as well as body form), appear to be the same in all the children studied, and not fundamentally different in either sex. But for the purposes of reference, it should be stated that of the 18 children at term, 10 were boys, 7 girls, and in 1, the sex was not noted; in Class 0, all 3 were boys; while in the 20 between the 4th and 8th months of intra-uterine life, 9 were boys, 8 girls, and in 3, the sex was not noted. The details are given in Table I.

TABLE I

SEX OF THE 41 CASES STUDIED:
21 AT TERM; 20 BETWEEN THE 4TH AND 8TH MONTHS

Class 0: 3 cases
3 boys

0-XIII	boy
0-XXVII	"
0-XL	"

Class 9: 18 cases
10 boys
7 girls
1 not noted

9-IV	boy
9-VI	"
9-VII	girl
9-IX	boy
9-XII	girl
9-XV	boy
9-XXII	girl
9-XXV	boy
9-XXVI	girl
9-XXVIII	not noted
9-XXXVI	boy
9-XXXVII	"
9-XXXVIII	girl
9-XXXIX	boy
9-XLII	"
9-XLV	girl
9-XLVI	boy
9-XLVIII	girl

Class 8: 3 cases
2 boys
1 not noted

8-XXXI	not noted
8-XLI	boy
8-XLIV	"

Class 7: 3 cases
1 boy
2 girls

7-XVIII	girl
7-XXIV	boy
7-XLVII	girl

Class 6: 6 cases
5 boys
1 girl

6-XIV	boy
6-XIX	"
6-XX	"
6-XXXIII	"
6-XXXIV	girl
6-XLIII	boy

Class 5: 5 cases
1 boy
3 girls
1 not noted

5-X	not noted
5-XI	girl
5-XVI	"
5-XXIX	"
5-XLIX	boy

Class 4: 3 cases
2 girls
1 not noted

4-XVII	girl
4-XXIII	"
4-L	not noted

The results of the study indicated above are arranged in the following four sections.

Section I. The Abdominal Viscera.

Section II. The Abdominal Walls.

Section III. Influence upon the Abdominal Viscera and Walls of the Experimental Introduction of Factors of Postnatal Environment.

Section IV. Complete Original Records of Each Case.

SECTION I—THE PRENATAL ABDOMINAL VISCERA

Certain Details of the Prenatal Evolution of the Abdominal Viscera from the Fourth to the Ninth Months, Inclusive: with Special Reference to the Status at Term.

GENERAL VIEW OF THE VISCERA ON OPENING THE ABDOMEN

The following is an attempt to draw a picture which shall fairly average the abdominal viscera at term, as found in 18 cases. It must be repeated that some details of this picture might equally well represent similar details of the abdominal viscera at varying periods of fetal life, as far back as the 4th month.

On opening the abdomen of the child at term, one is first struck with the presence of the bladder; with the large size of the liver; with the apparent absence of the great omentum; with the redundancy and large size of the sigmoid colon; with (except for the larger size and the longitudinal muscle bands) the almost constant absence of the characteristics which in adult life so readily distinguish the large, from the small, intestine; and with the presence of the greater part of the pelvic organs in the lower abdomen.

The bladder, with the voluminous remains of the urachus, occupies the greater portion of the median line below the umbilicus, extending laterally on both sides of this line, and extending upward as high as one-third to one-half the distance between the symphysis and the umbilicus. Turning it downward over the symphysis gives a free view of the abdominal viscera proper.

The great omentum is almost invariably folded upon itself and lying just above its attachment to the transverse colon; and it is of such extreme delicacy and transparency as to elude casual observation and be easily torn or destroyed.

The distinguishing characteristics of the large intestine in the adult are the sacculations, the longitudinal muscle bands and the appendices epiploicae. In the cases examined by the writer, the sacculations were almost completely absent; in 1 case, no trace of the longitudinal muscle bands could be found in certain areas; and the appendices epiploicae were never found.

After turning the bladder downward over the symphysis, the most prominent viscera are the liver, the sigmoid colon and the small intestines.

The liver monopolizes the right upper quadrant of the abdomen and a considerable portion of the left upper quadrant; and, sometimes, the upper part of the right, or even also of the left, lower quadrant.

The sigmoid colon is generally distended, and filled with meconium, occupying the left lower quadrant of the abdomen and the hypogastrium, behind the bladder, and extending, usually, in one or more large loops over a greater or less portion of the abdomen, below the liver, overlapping the small intestines or crowding them to the right side.

If the left lobe of the liver be not very large, or if the stomach be distended a small portion of the rounded greater curvature may project below the margin of the left lobe; and in this case, the transverse colon is visible at a still lower level, from a little to the left of the median line to the neighborhood of the left costal margin. If the stomach be empty, it is not usually seen except by lifting up the left lobe of the liver several millimetres; then the pylorus and antrum are first seen, lying in the median line and to its left.

By lifting the left lobe of the liver still higher, the body and fundus come into view, lying upon the diaphragm (which intervenes between the stomach and the posterior trunk wall), and extending up under the left lobe of the liver and the vault of the diaphragm. In such cases, usually only a small loop of the transverse colon is visible, to the right of the left costal margin and just below the left lobe of the liver. In some cases, this loop is distended, and it then projects downward into the abdomen; and, sometimes, one or two smaller loops also project downward, to the right of this one.

Occasionally, the descending colon is distended and projects into view at the extreme left of the abdomen, looking like another limb or loop of the sigmoid colon. But as a rule, the descending and ascending colons, the cecum and both kidneys are hidden from view by the coils of small intestine which are everywhere visible between the boundaries of the liver, the transverse colon and the sigmoid colon.

In girls, when the sigmoid colon is removed from the hypogastrium, the fundus and body of the uterus are seen behind it, the tubes and ovaries lying on either side. While the terminal sigmoid colon, at its junction with the rectum, is in relation with the uterus posteriorly.

THE PRENATAL LIVER

Note. It will be remembered that the prenatal class is divided into sub-classes according to individual age, the class number always representing the age of the child, thus, Class 4 means a four months' fetus; Class 5, a five months' fetus; and so on; Class 9 means a child at term, and Class 0 means a child born at term that lived not longer than 24 hours. (0-XIII lived about 16 hours; 0-XXVII, about 18 hours; 0-XL, about 24 hours).

Right Lobe: Location of Lower Border. (Plates I, II; Table II)

The predominant tendency of the lower border of the right lobe is to reach (in the mid-axillary line) the level of the apex of the right 12th rib at term. But this level may be reached as early as the 5th month, or it may be delayed till some postnatal period.

The lowest level noted (at the crest of the right ilium) occurs in the youngest cases (at the 5th and 4th months) but it was also found persisting in nearly a fourth of the cases at term.

TABLE II

LOCATION OF THE LOWER BORDERS (MID-AXILLARY LINE) OF THE RIGHT LOBE OF THE LIVER, AT TERM, AND BETWEEN THE 4TH AND 8TH FETAL MONTHS, GROUPED FOR COMPARISON

Case No.	Neighborhood of level of apex of right 12th rib	Between the right 12th rib and the crest of the right ilium	Neighborhood of level of crest of right ilium
9-XXXIX	Level apex right 11th* rib	..	..
9-XLVI	Level apex right 11th rib	..	..
0-XXVII	Level apex right 12th rib	..	..
9-IV	Level apex right 12th rib	..	..
9-XII	Level apex right 12th rib	..	..
9-XV	Level apex right 12th rib	..	..
9-XLII	Level apex right 12th rib	..	..
9-XLVIII	Level apex right 12th rib	..	..
7-XVIII	Level apex right 12th rib	..	..
5-XVI	Level apex right 12th rib	..	..
9-XXXVII	Just below level apex right 12th rib	..	..
8-XLIV	3 mm. below level apex right 12th rib	..	..
6-XLIII	4 mm. below level apex right 12th rib	..	..
9-XXVIII	5 mm. below level apex right 12th rib	..	..
5-XLIX	5 mm. below level apex right 12th rib	..	..
9-IX	8 mm. below level apex right 12th rib	..	..
7-XLVII	8 mm. below level apex right 12th rib	..	..
0-XIII	10 mm. below level apex right 12th rib	..	..
9-XLV	12 mm. below level apex right 12th rib	..	..
8-XLI	..	One-third distance from level right 12th rib to crest of right ilium	..
0-XL	..	Midway between right 12th rib and crest of right ilium	..
7-XXIV	..	Midway between right 12th rib and crest of right ilium	..
6-XIV	..	Midway between right 12th rib and crest of right ilium	..
6-XIX	..	Midway between right 12th rib and crest of right ilium	..
5-XXIX	..	Midway between right 12th rib and crest of right ilium	..
9-XXXVIII	..	..	5 mm. above level of crest of right ilium
9-VI	..	..	Level of crest of right ilium
9-XXII	..	..	Level of crest of right ilium
9-XXV	..	..	Level of crest of right ilium
5-XI	..	..	Level of crest of right ilium
4-XVII	..	..	Level of crest of right ilium
Total 31	19	6	6

*This may be at the same level, or lower, or perhaps higher than the apex of the 12th rib, owing to the variations in the length of the latter rib.

From the lowest point, the lower border passes in a more or less oblique line to the left and upward, to the median fissure. Sometimes, it passes more or less horizontally towards the median line before ascending more or less abruptly.

LEFT LOBE: LOCATION OF LOWER BORDER. (Plates I, II; Table III)

The left lobe of the liver usually descends more or less abruptly from the median fissure for a short distance; sometimes it descends so that its lower border is almost as low as the lower border of the right lobe; in one case, it descended so that it was even lower than the right (9-XXVIII).

TABLE III

LOCATION OF THE LOWER BORDERS (PASSING UNDER LEFT COSTAL MARGIN) OF THE LEFT LOBE OF THE LIVER, AT TERM AND BETWEEN THE 4TH AND 8TH FETAL MONTHS, GROUPED FOR COMPARISON

Case No.	Between the left 7th and 10th costal cartilages	Below the left 10th costal cartilage
0-XL	Under left 7th costal cartilage at level of junction with its rib	..
9-XXXIX	Under left 7th costal cartilage at level of junction with its rib	..
9-XXXVII	Between 7th and 8th costal cartilage	..
0-XXVII	Under left 8th costal cartilage	..
9-XV	" " " " "	..
9-XXII	" " " " "	..
9-XLII	" " " " "	..
8-XLI	" " " " "	..
5-XXIX	" " " " "	..
9-XLVIII	Under left 9th costal cartilage	..
8-XLIV	" " " " "	..
7-XXIV	" " " " "	..
7-XLVII	" " " " "	..
5-XLIX	" " " " "	..
9-XXV	Under left 10th costal cartilage	..
9-XXVIII	" " " " "	..
9-XLV	" " " " "	..
9-XLVI	" " " " "	..
7-XVIII	" " " " "	..
6-XIV	" " " " "	..
6-XIX	" " " " "	..
6-XLIII	" " " " "	..
5-XVI	" " " " "	..
4-XVII	" " " " "	..
9-IV	..	Level apex left 11th rib
9-XXXVIII	..	" " " " "
9-XII	..	15 mm. above level apex left 12th rib
0-XIII	..	5 mm. above level apex left 12th rib
9-IX	..	3 mm. below level apex left 12th rib
9-VI	..	10 mm. above crest left ilium, in mid-axillary line
5-XI	..	10 mm. above crest left ilium, in mid-axillary line
Total 31	24	7

After thus descending, the left lobe may retain this volume till its lower border passes the line of the left costal margin, whence its volume rapidly diminishes. Most often, however, its volume diminishes earlier; then, after its initial descent from the median fissure, the lower border ascends more or less obliquely, disappearing under the left costal margin anywhere from the level of the junction of the 7th to the 10th ribs with their cartilages, or at the level of the apices of the free ribs, though, occasionally, it may reach almost the level of the crest of the left ilium.

While the predominant tendency of the lower border of the left lobe is to reach the left costal margin between the 8th and 10th costal cartilages (at the level of the junction of these with their ribs) both at term and in the fetal cases, yet the lowest level noted (10 mm. above the crest of the left ilium) is seen in one case at term and in one case in the 5th month.

Again, twice as many cases at term ascend above the 10th costal cartilage as reach the 10th; while only as many of the fetal cases ascend above the 10th costal cartilage as reach it.

And of the ascending fetal cases, the highest point is reached by one in the 8th month and one in the 5th month; while nearly one-third of the cases at term still linger at the level of the 11th and 12th ribs.

The line of disappearance of the lower border of the left lobe under the costal margin does not necessarily correspond with the limit of extension of this lobe to the left. In two records (9-XXXIX, 9-XLVIII), the left lobe completely covered the stomach and spleen, and extended to the left lateral wall of the abdomen. In these two cases, its lower border disappeared under the left costal margin at the 7th and 9th costal cartilages, respectively.

MEDIAN FISSURE: VERTICAL AND HORIZONTAL LOCATION. (Plates I, II)

The median fissure is found to the right of the median line in 10 records at term and in 10 fetal cases: in one case at term (0-XL), as much as 22 mm. to the right; and in one fetal case (7-XLVII), as far as 12 mm. It was found in the median line in one case at term and in one fetal case (5-XLIX).

The location of the median fissure below the gladiolus varies pretty constantly but tends to range between 23 and 47 mm. below this point at term; and from 18 to 24 mm. below this point in the fetal cases. Or, at levels varying up to two-thirds of the distance downward from the gladiolus to the umbilicus in both groups, descending to just above the umbilicus in 1 case in the 4th month (4-XVII).

The median fissure does not exactly correspond to the lowest portion of the edge of the liver in this region because small portions of liver tissue from both lobes usually project somewhat below the margin of the fissure. Hence, the base of the fissure does not necessarily correspond with the lowest point of liver dullness in the line of its location.

ANATOMIC VARIATIONS NOTED

The anatomic variations noted in the liver refer principally to the locations of the right and left lobes and of the median fissure, as indicated in the preceding pages.

Extension of the left lobe of the liver to the left so that it completely covered the stomach and spleen and extended to the left lateral wall of the abdomen, was noted in two cases at term (9-XXXIX, 9-XLVIII).

Unusual extension of the liver tissue below and beneath the median fissure was noted in several cases. In 1 (9-XLV), this fissure was for a short distance converted into an hepatic canal, (from which the umbilical cord emerged) by a small triangular, tongue-shaped lobe, connecting the right and left lobes, and measuring 12 x 5 x 4 mm.

Pathologic Variations Noted

In several cases, the imprint of one or more ribs was found on the liver. This appeared to be a post-mortem change, resulting from close contact. The imprints were whitish and sodden and resembled the post-mortem appearance of the dome of the liver when it was displaced from the diaphragm.

THE PRENATAL SIGMOID COLON

Most Striking Characteristics of the Sigmoid Colon

The most striking characteristics of the prenatal sigmoid colon, as observed in this study, are its disproportionately large calibre as compared with the other divisions of the colon; its distention with meconium; its extension over the abdomen in redundant[2] loops; and its practical absence of sacculations.

Location: Classification of Location Along Four Lines (Fig. 1; Plates III-IV)

In 28 cases (15 at term; 13 fetal cases), the sigmoid colon is thrown into strong relief by its large size and dark color (due to its contained meconium). In all cases it occupies the left iliac fossa, the left lower quadrant of the abdomen and the hypogastrium, behind the bladder (and also the uterus, in the female—though an anterior coil tends to rest upon and obscure the fundus); and it may extend in one or more large loops upward in the left, or left and median, abdomen, and even also into the right abdomen overlapping the small intestines or even crowding them to the right side; or it may extend to the right, instead of upward, lying across the pelvis, into the right iliac fossa, and perhaps thence extending upward in the right abdomen.

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[2] When the length of any portion of the intestine is greater than the length of its attachment to the posterior abdominal wall or to another viscus (as the attachment of the transverse colon to the stomach by means of the gastrocolic ligament), this portion of the intestine is called redundant.

In all prenatal cases, from at least the 4th month onward to term, the sigmoid colon was found located along the same four definite lines.

These four lines of location are noted as follows:—

(a) 11 cases (4 at term; 7 fetal cases)—left iliac fossa, hypogastrium (behind the bladder) and ascending more or less in the left pelvic or suprapelvic abdomen: 0-XL, 9-XXII, 9-XXXVII, 9-XXXIX, 8-XLI, 7-XVIII, 6-XIV, 6-XIX, 5-XXIX, 4-XVII, 4-XXIII.

(b) 9 cases (6 at term; 3 fetal cases)—left iliac fossa, hypogastrium and ascending in the left, and thence to the right abdomen: 0-XXVII, 9-XXV, 9-XXVIII, 9-XXXVIII, 9-XLII, 9-XLVI, 8-XLIV, 7-XLVII, 5-XVI.

(c) 4 cases (2 at term; 2 fetal cases)—left iliac fossa, hypogastrium and more or less in the right lower quadrant, without ascending in the abdomen: 9-IX, 9-XLVIII, 7-XXIV, 5-XLIX.

(d) 2 cases (1 at term; 1 fetal case)—left iliac fossa, hypogastrium and ascending into the right suprapelvic abdomen, impinging more or less on the right iliac fossa: 9-XLV, 6-XLIII.

2 cases are recorded "in the left iliac fossa, hypogastrium and ascending in the abdomen" but the side of the latter is not noted: 9-XII, 9-XV.

These lines of extension may be represented graphically, as in Fig. 1, but only one of these lines (a) is primary, the other three being derivatives of this through increased redundancy or displacement, or both (see Redundancy, and Migrations and Displacements).

Size—Length; Width

The length of the sigmoid colon was not measured systematically, but in 3 cases at term (0-XXVII, 9-XXII, 9-XXVIII), it varied as 150, 206 and 240 mm.; while in 1 other case (9-XXV), the pelvic-sigmoid colon alone measured 175 mm. The first two and the last of these cases had 2 abdominal loops, while the third had 3.

Individual loops which were measured (and not always the deepest loops in each case) in 2 of these cases, and in 2 others in which the total length was not noted, varied in depth[3] as 10 and 50 mm. (9-XXII); 33 and 45 mm. (9-XXVIII); 14 and 42 mm. (9-XLV); and 25 and 23 mm. (9-XLVI). The last three cases had each 3 abdominal loops, while the first had 2. (Plate IV).

In 8 of the 13 fetal cases, individual loops (and not always the deepest loop in each case) varied in depth as 4 mm. (4-XXIII); 8 mm. (6-XLIII, 5-XVI); 9 mm. (8-XLIV); 10 mm. (5-XXIX); 11 and 25 mm. (7-XLVII, 7-XVIII); and 45 mm. (8-XLI). 4 of these cases had each 1 abdominal loop; 2 had 2 loops; and 2 had 3 loops.

The disproportionately large calibre of the sigmoid colon (as compared with other divisions of the colon) was noted in all the prenatal cases but its width was not measured systematically. In 1 case at term which had 3 abdominal loops (9-XXVIII), this portion of the colon was described as being large and distended with meconium; in 1 case which had 1 abdominal loop (0-XL), it was described as being greatly distended. In the former, its width, empty and collapsed and with its walls in apposition, was 15 mm.; in the latter, it varied from 30 to 42 mm. In 6 other cases at term and in 1 case in Class 5 the sigmoid colon was described as being "distended" but no measurements were taken. (3 of these 7 cases had each 1 abdominal loop, 3 had 2, and 1 had either 2 or 3.) In 1 other case (5-XI), the whole colon was much diminished in width.

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[3] The depth of all intestinal loops is always measured in the concavity of the loop.

TERMINATION: COURSE PRELIMINARY TO. (Plates III, IV)

The limits of the sigmoid colon were considered as extending from the crest of the left ilium to about the 3rd sacral vertebra, the point of disappearance of the sigmoid meso.

In 14 of the 15 cases at term and in all of the 13 fetal cases, the sigmoid colon finally descended in the median line, occupying the middle of the sacrum. In the 1 remaining case (9-XLV), it made its final descent into the pelvis on the left side of the median line; in this case (a girl), the lower part of the uterus occupied the middle of the sacral concavity.

In a little more than two-thirds of the 15 cases at term (9), the sigmoid colon passes from the right to make its final descent into the pelvis; while in a little less than two-thirds of the 13 fetal cases (8), it passes from the left.

A study of the records in both groups seems to indicate that when the sigmoid colon lies to the left of the median line, it enters the pelvis from the left; while when it lies also to the right of the median line, it enters the pelvis from the right. One exception to this apparent rule is found at term (9-XLV) and one in Class 7 (7-XLVII).

An experimental study (Section III) reconciled both the apparent rule and the exceptions, and showed that the movable pre-terminal part of the sigmoid colon is the determining factor. This study also showed that this question has not the importance attributed to it by some anatomists since, at different times and under different circumstances, in the same patient, the sigmoid colon may enter the pelvis now from the right and again from the left.

COURSE AND ARRANGEMENT. (Plates III, IV)

Study of the 28 prenatal cases (15 at term; 13 fetal cases) shows that the sigmoid colon tends to follow fairly definite lines of arrangement.

The first part of the sigmoid colon (iliac-sigmoid) lies in the left iliac fossa, being directed from the crest of the ilium downward, inward and forward to the psoas muscle, at the brim of the pelvis.

To the right of the psoas, the sigmoid colon (pelvic-sigmoid) forms loops or coils which tend to pass upward in the abdomen. The primary direction of these loops appears to be upward in the left abdomen; one or more secondary loops may be placed to the right of the primary abdominal loop, and so tend to pass successively into the median and the right abdomen.

As the sigmoid colon turns, in the neighborhood of the left psoas muscle, to ascend to form this primary loop, it makes a U[4], the base of which lies in the left iliac or the hypogastric region.

The primary abdominal loop forms an inverted-U, the internal limb of which, sooner or later, reaches the median line and is continued downward into the pelvis where the sigmoid colon terminates in the rectum.

The first U, with its base in the neighborhood of the left psoas muscle, and the primary inverted-U loop described, thus together form a large reversed S which lies more or less obliquely, or even horizontally, in the left lower quadrant (and perhaps also a little in the left upper quadrant) of the abdomen, including the left iliac fossa.

This is the basic arrangement of the sigmoid colon. Should the redundancy of this portion of the colon be greater than will suffice for this arrangement, the sigmoid colon turns upward from the pelvis a second, or even a third time, forming a 2nd or a 3rd inverted-U loop, to the right of the 1st one.

In all these arrangements one or more of the loops may become displaced but their formation can be traced along these lines.

In no case examined by the writer were more than three abdominal inverted-U loops observed—these three were definitely formed, as above described, in 2 cases (9-XXVIII, 8-XLIV); while in 4 other cases, although displaced, they can be clearly traced (9-XLV, 9-XLVI, 7-XLVII, 6-XIX).

CLASSIFICATION OF THE SIGMOID COLON INTO THREE TYPES, ACCORDING TO THE NUMBER AND ARRANGEMENT OF ITS LOOPS AS FOUND SPONTANEOUSLY ARRANGED. (Plates III, IV; Tables IV, V).

As one studies the loops of the sigmoid colon, one notes the individual variations which exist at all prenatal ages from at least the 4th month onward to term, but one notes further that the cases tend to dispose themselves in three groups which may be considered as types.

The inverted-U form of the loops is determined primarily by the parietal attachment of the pelvic-sigmoid meso which passes more or less upward and inward, from the left psoas muscle at the brim of the pelvis to the 3rd, 4th or 5th lumbar vertebra, and then descends in the median line to the neighborhood of the 3rd sacral vertebra—this line of attachment making an inverted-U (or V), with an oblique external limb, a vertical median limb and an apex directed upward.

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[4] Minor formations may sometimes be elaborated. Those noted here are enumerated either because they are such as quickly catch the eye, or because they are of value in showing relations, and so are helpful in tracing or retracing loop displacements.

The basic or 1st type is characterized by the projection upward of 1 inverted-U loop into the left pelvic or suprapelvic abdomen—only the primary abdominal inverted-U loop being formed.

The 2nd type is characterized by the presence of two abdominal inverted-U loops—a second abdominal inverted-U loop being formed to the right of the primary one.

The 3rd type is characterized by the presence of three abdominal inverted-U loops—two secondary abdominal inverted-U loops being formed to the right of the primary one.

In the at term and in the fetal cases, the 1st type was found in the proportion of 5 out of 15 cases, as compared with 6 out of 13; the 2nd type, in 6 out of 15, as compared with 4 out of 13; and the 3rd type, in 3 out of 15, as compared with 3 out of 13.

The most primitive form of the basic or 1st type was found in 1 out of 2 cases in Class 4, (4-XXIII), in which the sigmoid colon was very slightly redundant, its length closely approximating the length of the parietal attachment of its meso.

The 1st and 2nd types were found as early as the 4th month, and these types persisted at term in, respectively, one-third and a little over one-third of the cases. The 3rd type was found as early as the 6th month, and this type persisted at term in one-fifth of the cases.

The classification as to *type* is important because a lack of knowledge of type leads to confusion in studying both the prenatal and the postnatal evolution of the sigmoid colon.

The sigmoid colon abdominal inverted- U loops may become more or less displaced, so that the type is obscured.

These displacements follow definite paths so that (excluding occasional rotations of loops on their transverse or longitudinal axes, which may occur in any intestinal loop) the loops tend to move towards the right and downward (through the right oblique to the right horizontal positions), and thus they may be found anywhere from the left pelvic or suprapelvic abdomen to the right iliac fossa—the path of displacement describing more or less of an arc of a circle or ellipse, radiating from the primary parietal attachment of the pelvic-sigmoid meso as a centre, or from the secondary, unfixed bases of the individual loops.

Or, the loops may move towards the left and downward (through the left oblique to the left horizontal positions), so that they may be found anywhere from the left pelvic or suprapelvic abdomen to the left iliac fossa. Only the 1st abdominal loop was found thus displaced to the left horizontal, in this study, but a similar displacement to a left horizontal position may be found in other loops, elsewhere in the abdomen.

By returning displaced loops along the reverse of these paths (after correcting rotation around transverse or longitudinal axes), the original type may be disclosed and the case so classified.

The details given show the great individual variations in sigmoid colon loops which occur at all prenatal ages. Thus, Class 4 which demonstrates the most primitive length and one abdominal loop, also contains one case with two abdominal loops; and about as many cases of the 3rd type are found before term as at term—though it may have some significance that this type was not observed before the 6th month.

But these observations also show that the variations are not chaotic or anarchic but that they develop along definite lines from a constant unit; and that the essential factor in the individual variation is a varying redundancy of this portion of the colon.

REDUNDANCY: LOOPS; FORMATIONS—INVERTED-U, U-, S-, M-, OR W-SHAPED COLON IN THE LEFT, MEDIAN OR RIGHT ABDOMEN. (Plates III, IV; Tables IV, V).

Redundancy of the sigmoid colon to the right of the left psoas muscle (pelvic-sigmoid[5]), so that its length exceeds the length of the parietal attachment of its meso, is in this study of 28 cases a uniform prenatal development from at least the 4th month onward to term.

This redundancy leads to the formation of loops or coils, though the amount of the redundancy shows great individual variation.

It has been shown in the preceding chapters that these loops or coils follow quite definite lines of arrangement.

In viewing these arrangements, certain formations will catch the eye of the observer more quickly than will certain other formations. To some extent, this depends on the personal equation of the observer.

The dominant *formation* of the 1st type of sigmoid colon is the abdominal inverted-U; and the dominant formations of the 2nd and 3rd types are, respectively, 2 and 3 abdominal inverted-U's. Secondary formations (combined-U formations) are produced by the union of these abdominal inverted-U's with the iliac-sigmoid colon and with each other by simple U-loops. The *combined*-U formations which thus define themselves are M's, W's and (horizontal or oblique) S's and reversed S's.

Thus, the typical formations of the 1st type are 3 in number—1 abdominal inverted-U, 1 U, 1 horizontal reversed S.

The typical formations of the 2nd type are 9 in number—2 abdominal inverted-U's, 2 U's, 2 horizontal reversed S's, 1 M, 1 W, 1 horizontal S.

The typical formations of the 3rd type are 15 in number—3 abdominal inverted-U's, 3 U's, 3 horizontal reversed S's, 2 M's, 2 W's, 2 horizontal S's.

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[5] In 7 cases (2 at term; 5 fetal cases), more or less of a meso is present in the left iliac fossa. In 6 of these cases, this meso is more or less continuous with the descending meso, and in 3, with the pelvic-sigmoid meso, but redundancy of the iliac-sigmoid colon is not clear in any case.

Practically, the inverted-U, the horizontal reversed S, the M and perhaps the W are the formations which catch the eye, but a knowledge of the other formations may be of value in retracing the displaced loops and so in classifying as to type sigmoid colons which otherwise look confused, irregular or chaotic.

Modifications of the typical formations are constantly occurring, through migrations or displacements of the loops, causing variations in the number and kind of actually found loops or formations, but by applying the rules noted above (and later), the actually found loops and formations may, if displaced, be retraced to the typical ones, with identification of the original type of sigmoid colon.

Thus, in the 5 of the 15 cases which belong to the 1st type, there may be seen 1 U, 1 inverted-U and 1 oblique or horizontal reversed S, provided the primary abdominal inverted-U loop be not displaced too far downward to the right.

As a matter of record, these formations were thus typically seen in 3 of the 5 cases; and less typically in 1 other case which shows the primary abdominal inverted-U in process of displacement downward and to the right (9-XLII).

In the 5th case (9-XLVIII), the departure from type is pronounced but its classification is very simple by noting the above laws of displacement. The complete displacement of the inverted-U, downward and to the right, obliterates the U and the reversed S, enumerated above, and leaves only a horizontal U with base to the right. Retracing the path of displacement and moving the horizontal U upward and to the left, restores the inverted-U, the U and the reversed S, and reveals the typical 1st type of sigmoid colon.

The 2nd and 3rd types multiply these formations of the 1st type by 2 and 3, respectively. But they further add the formations produced by the union of the multiples of this basic group. These union formations are, as stated above, M's, W's, and horizontal or oblique S's and reversed S's.

Thus, the number of possible typical formations is readily ascertained by multiplying the number of formations typical of a certain type by the number of cases in which such type is found. But the number of actually found typical formations may be varied by the displacement of one or more of the primary abdominal inverted-U loops. Then, restoring the loops according to the laws of displacement above given, makes possible the classification of the case under its proper type.

Details of this study of formations are given in Table IV. One may summarize these details by saying that all of the 13 cases in which details are noted show 3 formations which are "present" "probable"[6] or "possible"[7]—1 inverted U, 1 U, 1 oblique or horizontal reversed S.

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[6] A formation is considered "probable" when the notes given in the records indicate such a formation, though the details be not full enough to describe it thoroughly. Thus in 9-XII, the notes say "the sigmoid colon lies in loops over the abdomen." This makes the assumption of at least 2 abdominal inverted-U loops "probable", though it does not contradict the "possibility" of 3 abdominal inverted-U loops.

These 3 formations alone belong to 5 of the 13 cases, and place these 5 cases in the 1st type. And any additional formations, such as S, M, or W, must mean a sigmoid colon of the 2nd or 3rd type.

5 of the 13 cases have these primary formations multiplied by 2; and, in addition, have 1 oblique or horizontal S, 1 M and (with the aid of the iliac-sigmoid colon) 1 more or less oblique and irregular W. And these formations place these 6 cases in the 2nd type. These formations may be modified by displacement but these displacements may be restored by the rules given above.

3 of the 13 cases have the primary formations multiplied by 3, plus twice the additional formations of the 2nd type. And these formations place these 3 cases in the 3rd type. These formations may be modified by displacement but these displacements may be restored by the rules given above and later. But a W formed without the aid of the iliac-sigmoid colon suggests a sigmoid colon of the 3rd type.

In the 13 cases at term in which details are noted, the 5 cases of the 1st type would typically furnish 5 abdominal inverted-U loops; the 5 cases of the 2nd type, 10; and the 3 of the 3rd type, 9—making a total of 24 abdominal inverted-U loops in the 13 cases, an average of 1.84 possible typical abdominal inverted-U loops per case.

Omitting all abdominal loops displaced from their typical inverted-U shape, and counting only those actually found in at least approximately such typical shape and position, leaves a total of 19 abdominal inverted-U loops in the 13 cases, an average of 1.46 actually found typical abdominal inverted-U loops per case. (Plate III; Table IV).

Again, one notes that in the 13 cases at term, the 5 cases of the 1st type would typically furnish 15 formations; the 5 cases of the 2nd type, 45; and the 3 of the 3rd type, 45—making a total of 105 formations in the 13 cases, an average of 8.07 possible typical formations per case.

The displacements noted cause such changes that in the same 13 cases, a total of 89 formations is actually found, an average of 6.84 actually found formations per case.

A similar study of the fetal cases in Plate IV and Table V will show the same laws at work as in the cases at term.

Comparing the two groups, one notes that the average number per case of possible typical abdominal inverted-U loops (meaning no loops displaced) and of actually found typical abdominal inverted-U loops (meaning those with identity not destroyed by displacement), in the 13 cases at term in which details are noted and in the 13 fetal cases, may be represented proportionately as 1.84 and 1.46 are to 1.76 and 1.30.

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[7] A formation is considered "possible" when the conditions existing are similar to those observed or demonstrated in another case. Thus, in cases in which "the sigmoid colon lies in loops over the abdomen," both 2 and 3 loops have been observed or demonstrated. Again, the primary abdominal inverted-U loop is converted by postnatal experiment into a right horizontal-U. The former position is then designated as "present", and the latter as "possible." When similar conditions are found existing in other cases, similar formations are called "possible".

And the average number per case of possible typical formations (meaning those formed by undisplaced loops) and of actually found formations (including those formed by displaced loops), in the 13 cases at term and in the 13 fetal cases, may be represented proportionately as 8.07 and 6.84 are to 7.61 and 5.00.

LOCATION OF FORMATIONS. (Plates III, IV; Tables IV, V)

In 3 of the 13 cases at term in which details are noted, the sigmoid colon formations extend into the left abdomen only; in 1, into the left and median abdomen; and in 9, into the left, median and right abdomen.

These locations of the sigmoid colon formations are those actually found and, hence, they group indiscriminately the locations of these formations in cases which have preserved the typical positions of their loops and in cases which have had their loops more or less displaced.

The results are often contradictory—as when, in the 1st type, the inverted-U loop is displaced to lie across the pelvis, and hence must be classified as lying in the left, median and right (pelvic) abdomen, while before displacement, it would be classified as lying in the left (pelvic or suprapelvic) abdomen; the sigmoid colon of the former location thus seeming to be longer or more redundant than that of the latter. And, as will be seen in studying displacements of the sigmoid colon loops the possibility of this source of error is always present.

An attempt was made to ascertain the probable amount of this error in the cases here studied.

The typical location[8] of the sigmoid colon formations (hence, with no displaced loops) in the 5 cases at term of the 1st type, is in the left abdomen; of the 5 of the 2nd type, in the left, or left and median, abdomen; of the 3 of the 3rd type, in the left, median and right abdomen.

This gives, in the 13 cases in which details are noted, an average typical location of 0.76 in the left, or left and median, abdomen; and of 0.23 in the left, median and right abdomen.

The actually found location (which includes displaced loops) in these 13 cases, is 4 in the left, or left and median, abdomen, and 9 in the left, median and right, abdomen; an average actually found location of 0.30

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[8] Typical resting positions of the three types of sigmoid colon in the at term cases, would appear to be represented:—1st type, by 0-XL, 9-XXXVII and perhaps 9-XXXIX (with 9-XLII and 9-XLVIII as modifications); 2nd type, by 9-XXII (with 0-XXVII, 9-XXXVIII, 9-XXV and 9-IX) as modifications; 3rd type, by 9-XXVIII (with 9-XLV and 9-XLVI as very atypical modifications).

Only 3 cases of the 3rd type were found but in these, a slightly right oblique position is suggested as typical for the 3rd loop; in all 3 cases, at least one limb of the 2nd loop is found in the median line; and in all 3 cases, the 1st loop is found in the left pelvic or supra-pelvic abdomen, in some variation of the left oblique position.

in the left, or left and median, abdomen, and of 0.69 in the left, median and right abdomen.

TABLE IV

THE 3 TYPES OF SIGMOID COLON, WITH THE FORMATIONS ACTUALLY FOUND, IN 15 CASES AT TERM

Type	Case No.	Inverted U (vertical oblique or horizontal)	U (vertical oblique or horizontal)	Reversed S (oblique or horizontal)	M (vertical or oblique)	S (vertical oblique or horizontal)	W (vertical or oblique)	Total Formations	Location
1st	0-XL	1	1	1	. .	. .	. .	3	l m.†
1st	9-XXXVII	1	1	1	. .	. .	. .	3	l*
1st	9-XXXIX	1	1	1	. .	. .	. .	3	l
1st	9-XLII	1	1	1	. .	. .	. .	3	l m r‡
1st	9-XLVIII	. .	2 (horizontal; 1 formed with aid of descending colon)	. .	. .	1 (vertical formed with aid of descending colon)	. .	3	l m r
2nd	0-XXVII	2	2	2	1	1	1	9	l m r
2nd	9-IX	. .	3 (horizontal)	1 (rotated posteriorly)	1 (horizontal)	1 (rotated posteriorly)	. .	6	l m r
2nd or 3rd	9-XII	2 (or 3)	Details not noted	Details not noted	Details not noted	Details not noted	Details not noted	Not noted	. .
2nd	9-XV	2	Details not noted	Details not noted	Details not noted	Details not noted	Details not noted	Not noted	. .
2nd	9-XXII	2	2	2	1	1	1	9	l
2nd	9-XXV	2	2	2	1	1	1	9	l m r
2nd	9-XXXVIII	2	2	2	1	1	1	9	l m r
3rd	9-XXVIII	3	3	3	2	2	2	15	l m r
3rd	9-XLV	2	3 (2 horizontal)	1 (irregular)	. .	2 (rotated posteriorly; 1 also to the right 1 horizontal)	. .	8	l m r
3rd	9-XLVI	4 (2 formed by displacement)	3	1 (irregular)	. .	1 (irregular)	. .	9	l m r

*l = Left abdomen
†l m = Left and median abdomen
‡l m r = Left, median and right abdomen

As the typical location above represents the actual number (3) of cases of the most redundant type of sigmoid colon (type 3), the inference is that the increased extension of the sigmoid colon over the left, median and right abdomen which was actually found, was due to displacement of loops to the right and downward—the typical location as compared with the actually found location in these 13 cases, being represented proportionately as 76 (in the left or left and median abdomen) and 23 (in the left, median and right abdomen) are to 30 and 69.

While in the fetal group, the typical location[9] as compared similarly with the actually found location, is represented proportionately as 76 and 23 are to 53 and 46.

TABLE V

THE 3 TYPES OF SIGMOID COLON, WITH THE FORMATIONS ACTUALLY FOUND IN 13 FETAL CASES, BETWEEN THE 4TH AND 8TH MONTHS

Type	Case No.	Inverted U (vertical oblique or horizontal)	U (vertical oblique or horizontal)	Reversed S (oblique or horizontal	M (vertical or oblique)	S (vertical oblique or horizontal)	W (vertical or oblique)	Total Formations	Location
1st	8-XLI	1	1	1	..	..	..	3	l*
1st	7-XVIII	1	1	1	..	..	..	3	l
1st	7-XXIV	..	1	..	..	..	..	1	l m r†
1st	5-XXIX	1	1	1	..	..	..	3	l
1st	5-XLIX	..	1	..	..	..	..	1	l m r
1st	4-XXIII	1	1	1	..	..	..	3	l
2nd	6-XIV	2	2	2	1	1	1	9	l
2nd	6-XLIII	1	2	..	..	1 (rotated posteriorly)	..	4	l m r
2nd	5-XVI	2	2	2	1	1	1 (irregular)	9	l m r
2nd	4-XVII	2	2	2	1	1	1	9	l m r
3rd	8-XLIV	3	3	2	1	..	..	9	l m r
3rd	7-XLVII	1	3	1	..	..	..	5	l m r
3rd	6-XIX	2	2 (horizontal)	1	1 (irregular)	..	..	6	l

*l = Left abdomen
†l m r = Left, median and right abdomen

But several factors must be considered in attempting to understand the variations in the location of the sigmoid colon formations.

(1) While the sigmoid colon tends to extend its area of location according to the number of its abdominal inverted-U loops, hence increasing from type 1 to type 3, yet considerable variation occurs.

Thus, type 1 might be expected to be found in the left abdomen; and it is so found in 2 of the 5 cases at term, and in 4 of the 6 fetal cases. In 1 case at term, it extends into the left and median abdomen. In the remaining 2 cases of each group, it is displaced so as to lie in the left, median and right abdomen.

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[9] Typical resting positions of the three types of sigmoid colon, in the fetal cases, would appear to be represented: 1st type, by 5-XXIX and, perhaps, 7-XVIII and 8-XLI (with 7-XXIV and 5-XLIX as modifications), with 4-XXIII as representing the basic primitive position of the primary sigmoid colon inverted-U loop; 2nd type, by 4-XVII and 6-XIV (with 5-XVI and 6-XLIII as modifications); 3rd type, not found typically in the fetal group (compare 9-XXVIII), 8-XLIV showing least striking departure from type, 7-XLVII more pronounced variation, and 6-XIX an interesting modification.

Type 2 might be expected to be found in the left and median abdomen, but it is not so found in any case noted. In 1 of 6 cases at term and in 2 of 4 fetal cases, it lies in the left abdomen. In 4 cases at term and in the remaining 2 fetal cases, it lies in, or is displaced into, the left, median and right abdomen. In the 1 remaining case at term its location in the abdomen is not noted.

Type 3 might be expected to be found in the left, median and right abdomen; and it is so found in all 3 cases at term, and in 2 of the 3 fetal cases. In the 1 exceptional fetal case, all 3 loops are found in the left abdomen. (The exceptional location of the sigmoid colon in this case may be explained by an exceptional displacement of the 1st abdominal inverted-U loop, leading to exceptional displacements of the other 2 abdominal inverted-U loops, under the operation of a law noted in a later chapter. (Migrations and Displacements of the Sigmoid Colon).

(2) There appears to be a definite tendency to extension of the sigmoid colon over a larger area of the abdomen as the child approaches term.

Thus, the sigmoid colon formations are found limited to the left abdomen in one-fifth of the cases at term (3 out of 15) and in over one-half of the fetal cases (7 out of 13); while they extend over the left, median and right abdomen in three-fifths of the cases at term (9 out of 15) and in less than one-half of the fetal cases (6 out of 13).

(3) A general increase in the size of the loops occurs as age increases towards term, not only as part of the general body growth but also from the increasing distension of this portion of the colon with accumulating meconium. This affects the size of the redundant loops, so that they occupy more relative space in the abdomen, but apparently it does not affect the number of loops, and so does not appear to alter the individual type. (Distension).

(4) The question of extension of the sigmoid colon over a larger area of the abdomen as the child approaches term should not be confused with extension of the sigmoid colon over the abdomen from displacement of its loops, though both may coincide.

The relation of displacement of the sigmoid colon abdominal inverted-U loops to extension of the sigmoid colon over the abdomen is shown in the study made in some of the preceding paragraphs.

It was there shown how displacement of the abdominal inverted-U loops increases the average of extension over the abdomen proportionately from 23 to 69, at term, and from 23 to 46, in the fetal group; these figures showing that extension over the abdomen from displacement of loops is relatively greater in the at term, than in the fetal, group.

There was also shown a slight but definite relative increase at term in both the typical and the actually found sigmoid colon abdominal inverted-U loops,[10] the proportion varying at term and in the fetal cases as 1.84 and 1.46 to 1.76 and 1.30. And there was shown a similar slight but definite relative increase at term in both the typical and the actually found sigmoid colon formations[10], the proportion varying at term and in the fetal cases as 8.07 and 6.84 to 7.61 and 5.00.

Hence, in attempting to ascertain the location of the sigmoid colon, one must consider three factors—the individual type; the question of displaced loops; and the age of the child, this latter being relatively more important as term is approached.

And experimental evidence shows, further, the influence upon location of the depth of the meso from parietal to visceral attachment; of the extent to which the depth of the meso is unfolded; and of shortening of the tube, as by the development of sacculations.

Experiment I. A pin is attached to the crest of the left ilium. One end of a string is tied to this pin. The other end of the string is carefully passed through the wall of the sigmoid colon at its origin, at the crest of the left ilium, and then through the entire length of the sigmoid colon and rectum, being brought out through the anus. The redundant sigmoid colon is then "gathered" or "fulled-up" by tightening this string. (This movement leads to unfolding of the meso since it tends to approximate a line leading from the anus to the crest of the left ilium; hence, it introduces an extraneous factor for which allowance must be made in interpretation).

In proportion to the closeness of this "gathering" or "fulling-up" process, the redundancy of the sigmoid colon is lessened and its extension over the abdomen and pelvis is curtailed.

When this gathering or fulling-up along the string is carried to a maximum, without making undue traction on the parietal attachment of its meso, the course of the sigmoid colon moves towards being confined to the left iliac fossa, the left lower quadrant of the abdomen and the hypogastrium, thus approximating the sigmoid shape of its parietal attachment. (1st type).

But this result follows only when the depth of the meso is such that its visceral attachment approximately parallels its parietal attachment, *i, e.* when the meso does not exceed a moderate depth and there are no great variations in its depth over a considerable area.

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[10] Considering the above observations, the inference seems justified that, apart from the variation in location due to type, to increased size from distension and to displacement of loops, there is an increased relative extension of the sigmoid colon over the abdomen as the child approaches term, this increased extension being probably due to some increased relative redundancy, as shown in a slight but definite increase in the *relative* number both of loops and formations.

This raises the question whether the type of sigmoid colon is always fixed for the individual or whether, and when, it may change during prenatal growth. For instance, may type 1, after appearing to be fixed for a given individual, increase in redundancy so that it may become type 2 or 3, and may type 2 increase so that it may become 3?

The preceding observations as to increase in the number of abdominal inverted-U loops and also of formations, in the child at term, suggest that some slight variation in this direction may occur. One also notes that type 3 was found only at term and in Classes 8, 7 and 6; hence, one can only say such a change of type may be possible, since variation in type seems to depend primarily on variation in redundancy, but the increase noted does not seem great enough to affect a large variation in type.

On the other hand, the predominant tendency, at least after a certain prenatal stage, seems to move towards a fixation of type for the individual: as evidenced by the persistence of types 1 and 2 at term; by the appearance of type 3 at least as early as the 6th month; and by the occurrence of types 1, 2 and 3 in about similar proportions at term and in the fetal group (5, 6 and 3 out of 14 as compared with 6, 4 and 3 out of 13).

In cases in which the depth of the meso is marked, either generally or in considerable areas, the sigmoid colon does not ascend approximately parallel to the receding angle of the inverted-U shaped parietal attachment of its meso, so as to form a primary inverted-U. In such cases, it tends to pass from the left iliac fossa to the hypogastrium and then to bend on itself to pass backward and downward in front of the sacrum, entering the pelvis from the right. Or, if the amount of redundancy be greater, it may pass across the hypogastrium, even into the right iliac fossa, or the right lower quadrant, before curving on itself to pass backward and downward in front of the sacrum, again entering the pelvis from the right. In these cases, the sigmoid colon resembles a shepherd's crook, more or less curved, and lying obliquely from the crest of the left ilium, the head directed downward and to the right, and backward. (Compare with 9-IX, 9-XLVIII, 7-XXIV, 5-XLIX, as found spontaneously arranged).

Again, there may be such regional variation in the depth of the meso that the primary inverted-U may be formed, and thence, distally, the depth of the meso may be so great that any of the variations in the hypogastrium and right pelvis just described may be added. (Compare with 7-XLVII, as found spontaneously arranged).

In the case of a very redundant sigmoid colon, the amount of fulling-up necessary to confine it to the line of the parietal attachment of its meso, is so great as to seem incompatible with visceral and circulatory activity in the living child. Hence, it would not seem probable that a 3rd type, or even a voluminous 2nd type might thus be converted into a 1st type.

But the two constant locations of the pelvic-sigmoid colon are (1) in the left lower quadrant of the abdomen, at the beginning of the parietal attachment of its meso, where the left psoas muscle passes over the brim of the pelvis; and (2) in the neighborhood of the promontory of the sacrum, the termination of the parietal attachment of its meso being in the neighborhood of the 3rd sacral vertebra.

Surgical Landmarks for Identifying and Tracing the Pelvic-Sigmoid Colon. (Plates III, IV).

Making an incision in the left lower quadrant of the abdomen, and taking the left psoas muscle at the brim of the pelvis for the first landmark (the external iliac artery here running along the inner border of this muscle), and the iliac-sigmoid colon in the left iliac fossa for the second landmark, the angle of junction between the fixed iliac-sigmoid and the movable pelvic-sigmoid is readily found at the first landmark, this angle opening upward. From this point, the whole pelvic-sigmoid colon, whether it be of the 1st, 2nd or 3rd types, may be drawn through the fingers and traced from left to right.

From an incision made elsewhere, as in the right lower quadrant or the median line, the beginning of the pelvic-sigmoid colon may be similarly identified by passing the examining hand across to the left psoas and the iliac fossa. But, from this latter incision, the length of the sigmoid colon may be examined more advantageously by identifying the sacral promontory as the first landmark and, after first passing upward from the fixed rectum, drawing the tube through the fingers from right to left.

RELATION OF THE LOCATION OF THE SIGMOID COLON LOOPS TO OTHER ABDOMINAL VISCERA.

(a) Relation of the location of sigmoid colon loops in the left abdomen to the liver. (Table VI).

In studying the liver, the question always arises why the lower border of the left lobe (taken as an index of the size of the lobe) retracts upward so much more rapidly than does that of the right lobe.

This question recurs as one notes the tendency of the sigmoid colon to project itself upward into the left pelvic and suprapelvic abdomen, and with increasing volume as the prenatal age advances.

And a second question then presents itself, "Does the predominant projection of the sigmoid colon upward into the left abdomen bear any except a coincidental relation to the predominant retraction of the left lobe of the liver upward in the left abdomen?"

An attempt to study this question in the 28 cases here under consideration (15 at term; 13 fetal cases) was made; and this study is summarized in Table VI.

With the present evidence, the only safe conclusions seem to be:

That the liver begins as a symmetrical, bi-lobed organ.

That the tendency of the sigmoid colon to project upward, in inverted-U loops, in the left abdomen is determined anatomically by the fact that the predominant parietal attachment of the pelvic-sigmoid meso is in the left abdomen, and that this attachment takes the shape of an inverted-U (or V).

That increased retraction upward of the lower border of the left lobe of the liver is here sometimes found well advanced, at least as early as the 5th, or even 4th, month of prenatal life.

That the predominant location of the sigmoid colon from at least the 4th month of fetal life to term, is that of projection upward, in inverted-U loops, into the left pelvic and suprapelvic abdomen.

That a larger number of observations than here given is needed to demonstrate whether there be any direct inter-relation between these two viscera, so that it may or may not be more than a coincidence that the recession of the left lobe of the liver continues till this lobe escapes from the restless region of the redundant loops of the sigmoid colon and the other hollow viscera of the left abdomen.

(b) Relation of sigmoid colon loops in the left abdomen to redundant loops of the subgastric transverse colon and of the descending colon. (Table VI).

The study of the left abdomen shows a predominance of colon loops, many of them of large size; not only, in every case (at least potentially), of the sigmoid colon but also in every case (at least potentially), of the

TABLE VI

RELATION OF THE LOWER BORDER OF THE LEFT LOBE OF THE LIVER TO PROJECTION UPWARD IN THE LEFT ABDOMEN OF SIGMOID COLON INVERTED-U LOOPS; TO PROJECTION DOWNWARD OF SUBGASTRIC TRANSVERSE COLON LOOPS; AND TO PROJECTION INWARD OF DESCENDING COLON LOOPS

as found in 15 cases At Term and in 13 Fetal cases between the 4th and 8th Months, grouped for comparison

Case No.	Lower border of left lobe of liver	Sigmoid colon loops in left abdomen	Subgastric transverse colon loops in left abdomen	Descending colon loops in left abdomen
0-XL	Junction of left 7th costal cartilage with its rib	1 loop present	Left portion of 1 shallow loop 15 mm. deep	. .
9-XXXIX	Junction of left 7th costal cartilage with its rib	1 loop present	1 loop, 20 mm. deep	. .
9-XXXVII	Between 7th and 8th costal cartilages	1 loop present	Potentially 2 loops	. .
0-XXVII	Left 8th costal cartilage	2 loops present	Left portion of 1 loop, potential	2 horizontal loops
9-XV	“ “ “ “	Details not noted	At least 1 potential loop	2 horizontal loops each 65 mm. deep
9-XXII	“ “ “ “	2 loops present	2 loops, 20 and 37 mm. deep	. .
9-XLII	“ “ “ “	None present for the moment	1 loop, 40 mm. deep	1 loop 12-13 mm. deep
8-XLI	“ “ “ “	1 loop present	1 loop, 45 mm. deep	1 small more or less fixed loop, 6 or 7 mm. deep
5-XXIX	“ “ “ “	1 loop present	1 loop, 30 mm. deep	. .
9-XLVIII	Left 9th costal cartilage	None present for the moment	2 loops, 13 and 21 mm. deep	1 loop extends inward to median line
8-XLIV	“ “ “ “	1 loop present	1 loop and part of a 2nd loop, 12 mm. deep	2 small more or less fixed loops, 6 mm. deep
7-XXIV	“ “ “ “	None present for the moment	Potentially 1 loop	. .
7-XLVII	“ “ “ “	1 loop present	Part of 1 loop, 9 mm. deep	1 small fixed loop, 5 mm. deep
5-XLIX	“ “ “ “	None present for the moment	1 loop, 9 mm. deep	1 small potential loop, 5 mm. deep
9-XXV	Left 10th costal cartilage	None present for the moment	1 loop, 35 mm. deep; part of a 2nd loop, 15 mm. deep	. .
9-XXVIII	“ “ “ “	2 loops present	At least 1 potential loop, 45 mm. deep	1 loop, 20 mm. deep
9-XLV	“ “ “ “	None present for the moment	1 loop, 20 mm. deep	. .
9-XLVI	“ “ “ “	1 loop present	Potentially 1 loop, 12 or 13 mm. deep	. .
7-XVIII	“ “ “ “	1 loop present	Probably at least 1 loop, 25 mm. deep	1 rather fixed loop, 15 mm. deep
6-XIV	“ “ “ “	2 loops present	Not noted	Not noted
6-XIX	“ “ “ “	2 loops present	At least 1 loop	. .
6-XLIII	“ “ “ “	None present for the moment	1 loop, 20 mm. deep	1 small fixed loop, 5 or 6 mm. deep
5-XVI	“ “ “ “	1 loop present	Potentially 1 loop, 19 mm. deep	. .
4-XVII	“ “ “ “	2 loops present	Potentially at least 1 loop	. .
9-XXXVIII	Level apex left 11th rib	1 loop present	1 loop, 45 mm. deep	. .
9-XII	15 mm. above level apex of left 12th rib	Details not noted	At least 1 loop potential, 15 mm. deep	. .
9-IX	3 mm. below level apex of left 12th rib	None present for the moment	Not noted	Not noted
4-XXIII	Not noted	1 loop present	Potentially at least 1 loop, 10 mm. deep	. .

subgastric transverse colon, and in at least 1 out of 3 cases at term, of also at least 1 descending colon loop, some of the latter deep enough to reach the median line.

The sigmoid colon loops tend to project upward, though they may for the moment be more or less displaced; those of the subgastric transverse colon tend to fall downward, though they may for the moment be potential, *i. e.*, more or less "fulled-up" below the greater curvature of the stomach; those of the descending colon tend to project inward towards the median line, and also sometimes forward, or more or less downward, though they may for the moment be potential, *i. e.*, more or less fulled-up along the course of the descending colon.

Hence, the decreasing left lobe of the liver is in relation with loops not only of the sigmoid colon but also of the subgastric transverse colon, and frequently also of the descending colon.

An attempt to study the relation of the sigmoid colon loops to these other colon loops (and, hence, a study of the colon loops of the left abdomen) was made, and this study is summarized in Table VI.

It is desirable to call attention to the varied combination of redundant colon loops (sigmoid colon, subgastric transverse colon and descending colon) which one may expect to find in the left abdomen, at all prenatal ages from at least the 4th month; with or without reference to the recession of the left lobe of the liver, as just discussed in (a).

And it is thus shown that in all cases, at all prenatal ages, one must remember the possibility of a loop of the subgastric transverse colon extending downward in the left abdomen; and that in at least one-fifth of the cases at term, a large loop of descending colon so extends into the left abdomen that it might easily be mistaken for a loop of sigmoid colon or a loop of subgastric transverse colon.

FIXED LOOPS. (Fig. 2)

Study is here made of the loop fixation which is developmental, in contradistinction to that which is pathological, in origin. In the developmental cases, the limbs of the loops are connected by tissue that can not be distinguished from the surrounding meso or peritoneum. When the connecting membrane appears to be adventitious or the result of adhesions due to a pathologic process, such fixation is called pathologic, and is referred to under Pathologic Variations Noted.

The formation of a developmental fixation of an intestinal loop seems to be accomplished through variations in mesenteric adhesion.

The line of parietal attachment of a mesentery may be curved so as to describe a loop. In such case, if the intestine is not redundant and if the adhesion of the meso is regular and complete, there occurs a formation that might be described as a fixed loop without a meso. The combined 2nd and 3rd (or 2nd, 3rd and 4th) portions of the duodenum typically form such a fixed loop. Fig. 2 (a). The pelvic-sigmoid colon would form such a fixed inverted-U loop should there be no redundancy and should no actual meso be present. Fig. 2 (a^1).

But the term fixed loop is usually applied to a loop formed by redundant intestine and one which has more or less of a meso in some portion. In such case, the meso of the loop may vary regularly in depth, this depth on the whole regularly increasing from the end of one of the limbs of the loop up to a certain point and then on the whole regularly decreasing to the end of the other limb, as in Fig. 2 (b); or, it may vary irregularly in depth, this depth having one or more areas of marked increase and diminution between the ends of the two limbs, making more or less fixed secondary loops, as in Fig. 2 (b^1).

So one might say that regardless of the shape of the parietal attachment of its meso, a fixed loop is developed whenever the adhesion of the meso of a redundant intestine is so irregular that the meso is greatly shortened in depth at two points, remaining deep enough between these two points to form a loop. In such case, the two areas of shortened meso hold the bases of the two limbs of the U-loop thus formed, and the loop is fixed by these attachments; while the position of this fixed loop may vary in proportion to the shallowness or depth of its meso attachments. Fig. 2 (b) (b^1).

In the pelvic-sigmoid colon, the line of parietal attachment of its meso describes an inverted U or V, the base of the external or left limb being fixed (by diminished depth of the meso) at the left psoas muscle, at the brim of the pelvis, while the base of the internal or right limb is fixed (by diminished depth of the meso) in the neighborhood of the 3rd sacral vertebra.

In this sense, every pelvic-sigmoid colon as a whole forms a fixed loop, of greater or less extent according to the degree of its redundancy, and of greater or less depth according to the depth of its meso.

In this sense, again, when we speak of displacement of the sigmoid colon, we mean displacement of a part or of the whole of this basal sigmoid colon fixed loop. This may seem a contradiction of terms. What really happens is that the base of this fundamental sigmoid colon loop remains fixed but the free bow of the loop is displaceable, the extent of possible displaceability depending primarily on the amount of redundancy (hence, on the length of the bow of the loop) and on the depth of the meso (hence, on the depth of the loop).

The simplest fixed loop thus formed is in the 1 of 2 cases in Class 4 which belongs to the first type of sigmoid colon. Here, the sigmoid colon is very slightly redundant and it nearly follows the line of the parietal attachment of the sigmoid meso, forming a small inverted-U loop, with a depth of only 4 mm.

The most extensive fixed loops thus formed are in the 6 cases of the 3rd type of sigmoid colon (3 at term; 1 each in Classes 8, 7 and 6). Here, the redundancy is so great that the bow of the basal loop falls into the primary abdominal loop of the 1st type and also into 2 secondary abdominal loops.

It is to be noted that the three loops in these cases are not fixed except as the whole sigmoid colon (of which they form festoonings) is fixed, at the parietal attachment of its meso. Thus, the left limb of the primary abdominal inverted-U loop is fixed at the left psoas muscle, at the brim of the pelvis, and the right limb of the 3rd abdominal inverted-U loop is fixed in the neighborhood of the 3rd sacral vertebra. Between these two points, the whole length of sigmoid colon is as free as the varying depth of its fan-shaped meso permits—the small end of this fan having the shape of an inverted-U or V. Fig. 2 (c).

And, were it not for the restraining influence of the other abdominal viscera and the abdominal walls, it is conceivable that in such cases as these, the sigmoid colon might under certain circumstances spread itself, in an expanded fan-shape (from its fixed base, the parietal attachment of its meso), over the whole abdomen—from the left hypochondrium to the right hypochondrium and then downward to the right pelvis, and not excluding the left pelvis.

The fixation of the left and right limbs by diminished depth of the sigmoid meso leads to the formation of this basal fixed loop consisting of the whole pelvic-sigmoid colon, provided the sigmoid meso deepens between these points of fixation. Such deepening always occurs, a meso being found present in all cases (Sigmoid Meso.)

This deepening of the sigmoid meso varies more or less in each case. And it might be thought that such variation might be the determining factor in the formation of the sigmoid colon loops, and so in the determination of the sigmoid colon types. A detailed study of the depth of the meso was not made but such observations of it as were made did not seem to have any definite bearing on these two points, though it remains possible that the meso variations may have at times a predisposing influence in determining or modifying the formation of a particular loop at a particular point. (Fig. 2 (c)).

In 28 cases (15 at term; 13 fetal cases), no definite secondary fixed loops—that is, no fixed loops other than of the sigmoid colon as a whole, as described above, were noted in the pelvic-sigmoid colon.

In 7 cases (9-XLV, 9-XLVIII, 8-XLI, 8-XLIV, 7-XLVII, 6-XIX, 5-XVI), an iliac-sigmoid meso was noted in the left iliac fossa, and in all except 6-XIX this meso was continuous with the descending meso. This suggests the possibility of the formation of a more or less fixed loop, in this region, consisting of the iliac-sigmoid and the descending colons, in combination.

Such a loop was noted in 1 case at term (9-XLVIII). In this case, the descending and the iliac-sigmoid mesos were both so deep in the neighborhood of the crest of the left ilium and the descending colon was so redundant, that it was impossible to say just when the descending colon and meso ended and the iliac-sigmoid colon and meso began, but the sigmoid meso was of considerable depth in the left iliac fossa.[11] But in the other 5 cases of the group, there was practically no redundancy of the intestine and such loop was not noted.

But even if no loop be formed, the existence of an unlooked-for meso in this region is of interest because it is possible for the intestine to swing on this meso. The knowledge of such a possibility in the left iliac fossa may be useful in explaining a condition which might arise from such displacement of this portion of the intestine inward, forward and upward. In such case, this mobile descending and iliac-sigmoid colon section might simulate one limb of a pelvic-sigmoid colon abdominal loop.

MIGRATIONS AND DISPLACEMENTS OF THE SIGMOID COLON LOOPS—ROTATIONS; INTERCHANGEABILITY; SLIDING. (Plates III, IV; Tables VII, VIII, IX)

The tendency of the sigmoid colon loops to migrate or be displaced from the primitive vertical position, in the left pelvic or suprapelvic abdomen, has already been studied to some extent in the chapters on Arrangement, Types, Redundancy and Formations.

As the common primary base of the sigmoid colon loops (the parietal attachment of the sigmoid meso) is fixed, practically all migrations or displacements of these loops occur by virtue of the rotation of the loops upon a series of axes—antero-posterior, longitudinal, transverse and oblique—movements occurring on these axes either singly or in combination.[12]

Minor displacements may take place as the result of interchangeability and sliding, these latter occurring with or without the addition of the rotations just mentioned.

(a) MIGRATIONS AND DISPLACEMENTS OF SIGMOID COLON LOOPS BY INTERCHANGEABILITY AND SLIDING. (Plates III, IV)

The absence of secondary fixed bases leads to a form of displaceability of sigmoid colon loops which may be called interchangeability. By means of this interchangeability, the different loops may shorten or lengthen themselves, the excess length of sigmoid colon tube passing into the continuing loop or loops.

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[11] In this case (9-XLVIII), the iliac-sigmoid meso is also continuous with the pelvic-sigmoid meso, which latter reaches a maximum of 63 mm. Note the modification in the iliac-sigmoid colon and the beginning pelvic-sigmoid colon in this case, due to the increased depth of their mesos. And one might imagine the possible variations had this case possessed a 2nd or a 3rd type of sigmoid-colon instead of, as it does, one of the 1st type. Compare with a case of the 3rd type in Class 6, in which a similar continuity of iliac- and pelvic-sigmoid mesos occurs. (6-XIX)

[12] Owing to the yielding nature of the anterior abdominal wall and the relatively more resistant nature of the posterior abdominal wall, more or less forward or forward and caudad, and the reverse, movement (by interchangeability, by sliding, or by more or less rotation on a transverse axis) probably occurs separately or accompanies all rotations upon the other axes. This variation is not considered in describing the movements on these other axes (1) because it has not been possible to define it accurately, and (2) because allusions to it, in the absence of some degree of accuracy, would add a complexity unnecessary at this stage of the study.

This process is seen manifesting itself in varying aspects, in 5 cases at term, (9-XXII, 9-XXV, 9-XXXVIII, 9-XLV, 9-XLVI) and in 4 fetal cases (8-XLIV, 7-XLVII, 6-XIX, 6-XLIII). But more or less interchangeability is undoubtedly constantly occurring in all loops.

As a loop is shortened by interchangeability, it may be further displaced by a simple sliding, its apex approaching the location of its base, as this latter moves downward, and both sliding lower in the abdomen. Thus, in 9-XLV, the 3rd loop becomes smaller through interchangeability, and it slides downward so as to become pelvic in location. This particular form of displacement may occur without any form of rotation, but in the loop just mentioned, a rotation forward and to the right upon a longitudinal axis, is added. Sliding is also well illustrated in 2 fetal cases (8-XLIV, 7-XLVII).

More or less sliding is probably constantly occurring in all loops as they rotate on their secondary, unfixed bases—these latter themselves undoubtedly constantly varying more or less.

One or both limbs of a loop may also slide laterally, (9-XXV^{1,2}, 9-XLVI^{1}), this movement occurring alone or in connection with some form of rotation.

(b) MIGRATIONS AND DISPLACEMENTS OF SIGMOID COLON LOOPS BY ROTATION UPON AN ANTERO-POSTERIOR AXIS. (Plates III, IV; Tables VII, VIII, IX).

The displacements studied in the previous chapters are principally those occurring as the result of rotation upon an antero-posterior axis.

As to the basic position of the primary inverted-U loop, one notes that the position of the inverted-U in the most primitive form found in this study (1 case in Class 4, 4-XXIII), in which there is very little redundancy, the sigmoid colon following quite closely the line of the parietal attachment of its meso, (this meso having a maximum depth of only 4 mm.) is vertical, in the left pelvic abdomen.

As the sigmoid colon increases in size (from age and other factors), the larger abdominal inverted-U loop tends to leave the vertical position and to rotate, to the left or to the right, upon an antero-posterior axis.

Rotation to the left may lead, in the left pelvic, or suprapelvic, abdomen, to overlapping of the descending colon or of the iliac-sigmoid colon; (0-XL, 9-XXII^{1,2}, 9-XXVIII^{1}, 8-XLI, 5-XXIX, 4-XVII) or to the passing of this latter and the assumption of a more or less left horizontal position, in the left iliac fossa; hence, from the vertical position, through the left oblique, to the left horizontal position.

Rotation to the left may also occur subsequent to rotation to the right, the loop re-entering the left abdomen from the right abdomen.

Rotation to the right may lead to passing of the loop, from the left pelvic, or suprapelvic, abdomen, successively through the median and the right abdomen to the right pelvis; hence, from the vertical position, through the right oblique, to the right horizontal position.

Rotation to the right may also occur subsequent to rotation to the left, the left oblique loop passing again through the vertical position to become right oblique.

Hence, when a loop is found in the vertical position, one can not from this observation alone know whether (1) the loop is in the primitive position and has not yet undergone any rotation upon an antero-posterior axis; whether (2) it is in process of rotating from the left oblique to the right oblique; or, whether (3) it is in process of rotation from the right oblique to the left oblique. Other factors must incline one to decide that one of these three possibilities is the more probable.

Both limbs of a loop may rotate similarly, or one limb may progress and the other lag more or less. This latter condition leads to opening of the loop and broadening of its apex (0-XXVII[2], 9-XLII, 8-XLI).

Rotation upon an antero-posterior axis, to the right and downward beyond a certain point (this point seeming to be in the neighborhood of the crest of the right ilium), is always typically followed by rotation forward and downward on a longitudinal axis, so that the abdominal inverted-U is finally converted into a more or less horizontal U which lies in the right iliac fossa, with its apex directed outward; the original left limb of the inverted-U becoming the anterior or lower limb of the more or less horizontal U. (An exception to this rule is noted in 1 fetal case, 6-XLIII).

Similarly, rotation upon an antero-posterior axis, to the left and downward, beyond a certain point (this point seeming to be about in the line of the iliac-sigmoid colon), is always typically followed by rotation forward and downward on a longitudinal axis, so that the abdominal inverted-U is finally converted into a more or less horizontal U which lies in the left iliac fossa, with its apex directed outward; the original right limb of the inverted-U becoming the anterior or lower limb of the more or less horizontal U. (An intermediate stage in this rotation is noted in 1 fetal case, 8-XLIV).

This is the usual final downward position of the migrating or displaced sigmoid colon loops, in both left and right abdomen or pelvis, and it requires a combined rotation upon both antero-posterior and longitudinal axes, or both rotations may be combined and the movement occur upon an oblique axis. An unusual final downward position may occur as the result of rotation forward and downward upon a transverse axis; this was seen in only 1 case at term (9-XLVI[3]) and in 1 fetal case (6-XIX[1]).

It seems plausible that (owing perhaps to the tension exerted on the outer or posterior limb of the loop by the diminishing sigmoid meso, as this latter approaches, respectively, its sacral extremity or its psoas extremity, or perhaps also to other factors) continued movement of the loop to the right and downward, or to the left and downward, can be accomplished only by its added forward rotation on a longitudinal axis.

Given the continuing impulse to move to the right and downward, or to the left and downward, if the outer or lower limb be retarded, and the median or upper limb left freer, rotation of the loop forward and downward, along a longitudinal axis, would naturally follow. Intermediate stages in this descent are observed, and these seem to confirm this hypothesis.

Again, given the continuing impulse to move to the right and downward, if the left or upper limb be retarded and the right or lower limb left free, opening of the loop and broadening toward the apex would be the logical sequence; and this condition is also observed.

The continued rotation to the left and downward seems to occur only when the 1st or primary abdominal inverted-U loop is small enough to fit horizontally into the left iliac fossa, and it was only seen associated with (by interchangeability) increased depth of the 2nd abdominal inverted-U loop, with corresponding decrease of the 1st.

One might think that a small 1st or primary abdominal inverted-U loop favors continued rotation on an antero-posterior axis, to the left and downward, to form a horizontal U. Or, one might think that perhaps it was the continued impulse to rotation on an antero-posterior axis, to the left and downward, that led (by interchangeability) to such decrease in size of the loop as made the horizontal U possible.

In other words, decrease in the size of the loop may favor its descent to the left iliac fossa; on the other hand, factors favoring its descent may favor decrease in its size.

A similar decrease in the size of the loop does not accompany rotation to the right horizontal position, allowing for its extension over the greater distance. This suggests the presence of a modifying factor for the pelvic-sigmoid colon in the left pelvic, or suprapelvic, abdomen, and the absence of this factor in the right. Such factor may be the increased parietal and meso resistance to which the sigmoid colon is subject in the left abdomen, as compared with the right (as will be discussed in a later paragraph), and such increased resistance would undoubtedly make for greater modeling power over the contained viscus.

The basic, primitive position of the primary abdominal inverted-U loop (in which no rotation has occurred) was not found at term. It was found in only 1 of the 26 prenatal cases (4-XXIII).

Rotation upon an antero-posterior axis is seen in the 13 cases at term in which details are noted, and in 12 of the 13 fetal cases (the 1 exceptional fetal case is noted in the preceding paragraph), the degrees of rotation varying from the vertical, through the left or right oblique, to the left or right horizontal (Tables VII, VIII, IX).

This rotation may occur towards the left or towards the right, soon adding a downward movement in either case.

Omitting the loops which appear to have undergone rotation first in one direction and then in the reverse direction, rotation from the primitive vertical position occurs in the at term cases, to the left and to the right in the proportion of 9½ (loops in 8 cases) to 11½ (loops in 9 cases)— a slight predominance of rotation to the right over that to the left.

And in the fetal cases, this rotation occurs to the left and to the right in the proportion of 9½ (loops in 8 cases) to 7 (loops in 6 cases)— a predominance of rotation to the left over that to the right.

Apparently, then, the pelvic-sigmoid colon migrates across the abdomen to both the left and the right; and, apparently, it may swing to the left and then to the right, or to the right and then to the left. Hence, some of the surplus loops in the right abdomen may be on a return swing to the left, just as some of the loops in the left abdomen have been traced en route from left to right, *i. e.*, from left oblique again to vertical (9-XLVI, 8-XLI, 7-XVIII, 5-XVI). But the identification of the return route in the right abdomen is more difficult because there does not appear to be as definite a resting position in the right abdomen as in the left abdomen[8-9].

Studying the rotations upon an antero-posterior axis, from the simplest to the most complex form of pelvic-sigmoid colon, *i. e.*, from the 1st to the 3rd types, one notes (Table IX) that while the at term group as a whole shows a slight predominance of rotation to the right over that to the left, this group predominance is seen to be due to the second loop in both 2nd and 3rd types, and to the third loop in the 3rd type; and the rotation to the right of these loops is probably a secondary rotation, the primary or 1st loop showing a predominant rotation to the left in all 3 types (Table IX).

And in the fetal cases, the group predominance of rotation to the left over that to the right is seen to be due to the first loop, this loop showing an exclusive rotation to the left in the 2nd and 3rd types, and a practically even division in the 1st type. And this predominance is not neutralized by the slight predominance of rotation to the right over that to the left in the second and third loops in the 3rd type—the second loop in the 2nd type showing an equal division between left and right.

There is one characteristic that is common to the terminal loop (whether it be a 1st, 2nd or 3rd loop) in all but 1 of the 9 cases at term and in all but 1 of the 6 fetal cases, which have loops in the right abdomen, *i. e.*, that some part of it (usually the terminal limb) lies in the neighborhood of the right sacro-iliac articulation. In 7 of the 9 cases at term and in 4 of the 6 fetal cases, some part of the terminal loop crosses the articulation; in 1 of each group, it lies above it. In the 1 exceptional case in each group (9-XLV, 7-XLVII) the terminal loop lies nearer the left sacro-iliac articulation, this loop having finally rotated to the left of the median line.

This characteristic of the terminal loop is a consequence of its rotation into the right abdomen, regardless of type. Thus, of the above 11 cases in which some portion of the loop was found lying across the articulation, 3 cases were of the 1st type, 5 were of the 2nd type, and 3 were of the 3rd type. Of the 2 remaining cases in which it lay just above the articulation, 1 was of the 1st type and 1 was of the 2nd type. And the two exceptional cases were of the 3rd type.

But this relation of the terminal loop to the right sacro-iliac articulation does not imply a right resting position (similar to the left oblique resting position which suggests itself) because the only feature common to these terminal loops is that the terminal limb of each lies sufficiently to the right of the median line to reach the neighborhood of the sacro-iliac articulation, as the loop swings on the decreasing depth of the terminal sigmoid meso (which ends in the neighborhood of the 3rd sacral vertebra).[13]

On the other hand, one notes (Plates III, IV) that the loops found in the left oblique position, as compared with those in the right oblique positions have not only greater uniformity and definiteness but they give the impression of greater stability and more the appearance of coming to a point of rest, impinging as they tend to do upon the descending and the iliac-sigmoid colons, as well as on the more resistant boundaries of the left pelvic, or suprapelvic, abdomen.[14]

All of the foregoing observations, taken in connection with certain experiments to be detailed later (Section III), suggest that although the primitive vertical inverted-U loop, as it increases in size and depth, may rotate upon an antero-posterior axis to either the left or the right, yet there is a fundamental predisposition for it to assume the left oblique position as a primary resting position. They also suggest that it may migrate from this primary resting left oblique position (1) to the left horizontal, (2) again to the vertical, (3) to the right oblique, or (4) to the right horizontal but that there is a constant tendency to return from these migrations to the left oblique resting position. And, further, that these fundamental characteristics of the primary inverted-U loop are shared by the secondary formations of 2nd and 3rd loops, though in less marked degree [8-9].

Nevertheless, there appears to be a condition in the right abdomen which acts similarly to the condition in the left abdomen, to inhibit the descent of the sigmoid colon loops into the horizontal position. But this inhibitory condition is more marked in the left abdomen (the horizontal position being found in only 1 loop, in 1 case) than in the right abdomen (3 loops, in 2 cases). And the action of an inhibitory force is more clearly discernible in the left abdomen than in the right abdomen, in that the left horizontal loop is always markedly decreased in size.

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[13] Although no definite tendency to a right oblique resting position is observed the decreasing depth of the terminal sigmoid meso must exert a restraining influence upon the rotation of at least the terminal loops to the right, upon an antero-posterior axis.

This is shown in the observations that such rotation does not continue as before beyond a certain point (in the neighborhood of the crest of the right ilium), and that continued movement of the loop beyond this point is attained by the upper or posterior limb of the loop (whose meso is deeper, being farther from the terminal point) swinging forward and downward, in front of the lower or anterior limb. Thus, rotation around a longitudinal axis is substituted for, or added to, the rotation around an antero-posterior axis.

[14] The only position in the right abdomen in which the loop gives a similar suggestion of definiteness, of stability, and of coming to a point of rest, is in the right horizontal position, the loop resting in the right lower quadrant or the right iliac fossa. But this position was found so seldom (3 loops in 2 out of 15 cases) that one does not feel justified in inferring that it is a primary resting position, occurring during the ordinary migration of the sigmoid colon.

Thus, it would appear that the sigmoid colon loops tend to reach a primary resting position in the left oblique position, and to some extent in the right oblique position. The favoring factors being less pronounced in the right abdomen, the right oblique position shows less uniformity and definiteness, suggesting that it is more unstable. It is also suggested that owing to this relative instability, an oblique position will more readily change to a horizontal position in the right than in the left abdomen.

The presence of a resting position to the left, for at least the 1st abdominal inverted-U loop, and the absence of a similar resting position to the right, is probably due to two factors:—(1) That the pelvic-sigmoid meso begins at the left brim of the pelvis, this minimum depth of meso tending towards curtailment of excursion, and towards restriction of at least the primary inverted-U loop towards the left; and (2) that the location of the beginning of the pelvic-sigmoid colon is closer to the left side of the abdomen, with its boundary of resisting muscular and bony walls, and its occupation by fixed descending and iliac-sigmoid colons. Hence, there is less space for movement to the left, and there are more conditions there tending to neutralize movement and bring it to rest.

On the other hand, if the impulse to movement be not neutralized or if other influences predominate, two factors favor its diversion to the right:—(1) The path to the right is easier because it leads towards the more spacious and less resisting median and median-right abdomen; and (2) Redundancy of the pelvic-sigmoid colon, as well as depth of its meso, both increase to the right of their beginning at the left psoas muscle, at the brim of the pelvis, both of these factors favoring freedom of excursion.

In the right abdomen, the sigmoid colon loops do not meet with the same factors favoring a resting position as those which exist in the left abdomen. (1) The diminution in depth of the sigmoid meso which exists at its termination, and which may be compared with that at its beginning, does not occur in the right pelvis, as does the latter in the left pelvis. This terminal diminution occurs in the median line, at or above the posterior brim of the pelvis. Therefore, such tendency to a resting position as may be due to a diminished depth of meso is much less to the right of the abdomen than it is to the left—the whole of the right half of the abdomen and pelvis being open to the right of the terminal meso, as compared with only the left iliac fossa and the suprapelvic abdomen above it, to the left of the beginning meso. And (2) this median attachment of the terminal sigmoid colon and meso leaves a large space in the right abdomen and pelvis medad to the resisting muscular and bony walls which form the right boundary of the abdomen (analogous to those forming the left boundary); hence, this boundary, even with its occupation by fixed ascending colon and cecum, does not exert a neutralizing effect on the movement of the sigmoid loops corresponding to that on the left side.

Apparently, then, the sigmoid colon, rotating on an antero-posterior axis, is, intrinsically, constantly subject to two opposing forces: (1) a primary pull to a resting left oblique position; and (2) a secondary pull to the greater freedom of a migration to all degrees of the right oblique, or even to the right horizontal, position.[15]

(c) MIGRATIONS AND DISPLACEMENTS OF SIGMOID COLON LOOPS BY ROTATION UPON A LONGITUDINAL AXIS. (Plates III, IV; Tables VII, VIII)

Rotation of loops around a longitudinal axis may be seen in 7 of the 13 cases at term and in 7 of the 13 fetal cases, in degrees varying from a merely perceptible beginning in one limb of a loop up to rotation of the entire loop one half turn.

This rotation may occur towards the right or towards the left, the forward coming limb of the loop being taken inversely as the index of direction (thus, in rotation to the right, the left limb comes forward and moves to the right; while in rotation to the left, the right limb comes forward and moves to the left). But the predominant rotation upon the longitudinal axis at term was forward and to the right, in the proportion of 10 (loops in 6 cases) to 2 (loops in 2 cases). The forward and downward rotation, in 2 cases in the former group (9-IX, 9-XLVIII) and in 1 case of the latter group (9-XLV), is really only a modification of rotation forward and to the right (as in the first two of these cases), or of forward and to the left (as in the last case); the final formation in these cases being the same whether the rotation be initiated or terminated upon the longitudinal or the antero-posterior axis.

And in the fetal cases, this rotation occurs to the right and to the left in equal proportions (6 loops in 5 cases in each).

Attempting to understand the great predominance of rotation to the right around a longitudinal axis, one notes (Table VII) that of the 11½ loops rotated at term from the primary vertical position to the right, around an antero-posterior axis, 9 have an added rotation around a longitudinal axis, this latter rotation being also to the right; while of the 9½ loops rotated from the primary vertical position around an antero-posterior axis, to the left, only two have an added rotation around a longitudinal axis, this latter rotation being also to the left.[16]

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[15] Certain extrinsic postnatal factors have been observed to reinforce or to antagonize these intrinsic forces but a discussion of these postnatal factors must be reserved for a later chapter. (Section III).

And in the fetal cases, one notes (Table VIII) that of the 10½ loops rotated from the primary vertical position to the left, around an antero-posterior axis, 5 have an added rotation around a longitudinal axis, this latter rotation being, in 4 of the 5 loops, also to the left; in the 5th loop, this added rotation is to the right (6-XIX[2]).

These observations suggest that rotation around a longitudinal axis seems to follow in direction the rotation around an antero-posterior axis (from the primary vertical position) as, with the two exceptions noted (9-XLV, 6-XLIII[17]), all longitudinal rotations to the right coincided with antero-posterior rotations to the right and all longitudinal rotations to the left coincided with antero-posterior rotations to the left.

Given a loop rotating upon an antero-posterior axis, a retardation of its leading, or lower, limb would favor rotation upon a longitudinal axis if this retardation were not shared by the other limb; while an opposite retardation would cause opening of the loop and broadening of the apex. This latter form of loop change has been observed in process of development, and has been already noted in this chapter; and the former variety of loop change has been observed in all loops which have reached the horizontal, whether right or left.

But since rotation around an antero-posterior axis occurs nearly equally to the left and to the right, the above proportional figures suggest some added factor which favors longitudinal rotation to the right, and which is either not present or which inhibits such rotation to the left.

This factor may be the relatively diminished resistance offered by the median and median-right abdomen, and the relatively increased resistance offered by the left abdomen. This variation in resistance, embracing abdominal wall and sigmoid meso, has already been noted in a previous section of this chapter.

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[16] In the 3 loops, in 2 cases (9-XLV, 9-XLVI) in which rotation around an antero-posterior axis appears to have occurred first in one direction and then in the reverse direction (2 from the right abdomen to the left, and 1 from the left oblique position to the vertical), additional rotation around a longitudinal axis exists in only 1, and this does not follow the uniform course noted above.

In this case (9-XLV[3]), retracement of the displaced loop suggests that rotation around a longitudinal axis to the right may have coincided with rotation around an antero-posterior axis to the right when this 3rd loop occupied its typical position. In the secondary rotation around an antero-posterior axis to the left which the loop has undergone, to bring it to its present position of a little to the left of the median line, the rotation to the right around a longitudinal axis, appears still to predominate. (Compare with 7-XLVII[3]).

[17] In this case (6-XLIII), the 2nd loop rotates so that the right or lower limb passes forward and upward in front of the left or upper limb, the equivalent in action of the usual rotation to the left on a longitudinal axis (this rotation might be considered as being backward and to the right, if one considered the left or posterior limb as the leading one).

If this loop had rotated on a longitudinal axis in the opposite, or usual, way (forward, downward and to the right), it would then lie horizontally in the right iliac fossa or pelvis. In such case, the limb formed by the terminal sigmoid colon would lie behind the other limb, instead of in front of it (compare 7-XXIV and 5-XLIX).

But the question still remains, why should the "leading" limb of a loop be retarded from moving, or falling, forward more often than the "following" limb? Is it that this "leading" limb which tends to become the lower limb, is more subject to the influence of factors which tend towards neutralizing movement? We have already noted the influence of the diminishing depth of meso in this direction, in the case of loops assuming the right horizontal and the left horizontal positions.

It may further be observed that (other things being equal) as an inverted-U loop rotates upon an antero-posterior axis, it tends to close the U which is continuous with it on the side towards which rotation is proceeding. This closing of the U tends to bring its two limbs towards contact with each other and thus to move towards retardation of the movement of its following limb. But this following limb of the U is also the leading limb of the inverted-U loop which is rotating upon an antero-posterior axis. And it suggests itself that this retardation of the limb which is common to both the inverted-U and the U may be the factor which inaugurates an added rotation of the inverted-U (in the same direction) upon a longitudinal axis.

But this result would assume that the closed U would remain in the same vertical plane. Should it leave this vertical plane, as by rotation forward and cephalad, on a transverse axis, then the inverted-U loop, meeting with diminished resistance, might continue its rotation around an antero-posterior axis without adding rotation around a longitudinal axis (9-XXXVIII, 5-XVI).

(d) MIGRATIONS AND DISPLACEMENTS OF SIGMOID COLON LOOPS BY ROTATION UPON A TRANSVERSE AXIS. (Plates III, IV; Tables VII, VIII)

In all movements of the sigmoid colon, as already stated, more or less forward movement is apt to be added[12] but definitely developed rotation around a transverse axis was noted in only 1 of the 13 cases at term and in 1 of the 13 fetal cases, this rotation being forward and downward one half turn. In the former case, it was found in a third loop, in a case of the 3rd type; in the latter case, it was found in a first loop, also in a case of the 3rd type.

(e) MIGRATIONS AND DISPLACEMENTS OF SIGMOID COLON LOOPS BY ROTATION UPON AN OBLIQUE AXIS. (Plates III, IV; Tables VII, VIII)

Rotation of the loop en masse forward, downward and to the right, upon an oblique axis, might be considered as explaining the conversion of the abdominal inverted-U loops into the horizontal-U loops found in the right iliac fossa, in 3 loops in 2 cases at term, and in 3 loops in 3 fetal cases.

And experiments with postnatal factors of environment have demonstrated that this form of rotation may occur (Section III).

But so many intermediate stages are found in this study that the inference seems justified that this conversion is more apt to occur, at least in prenatal life, as the result of rotation of the loop to the right and downward, upon an antero-posterior axis, combined with rotation forward and downward, upon a longitudinal axis.

Similar inferences seem justified regarding the conversion of the abdominal inverted-U into the horizontal-U loop found in the left iliac fossa in 1 loop in 1 case at term and in 2 loops in 2 fetal cases, but with more force since this latter displacement was never produced experimentally.

Rotation to the right and to the left, as might occur upon an oblique axis, was found in the proportion of 3 (loops in 2 cases) to 1 (loop in 1 case) at term, and in the proportion of 3 (loops in 3 cases) to 2 (loops in 2 cases) in the fetal cases.

TABLE VII

ROTATION OF LOOPS IN THE THREE TYPES OF SIGMOID COLON AS FOUND AT TERM: GROUPED ACCORDING TO AXES AND THE DIRECTION OF ROTATION

	1st type (5 cases)	2nd type (5 cases)	3rd type (3 cases)
On an antero-posterior axis			
Left, from vertical			
to left oblique	0-XL 9-XXXVII 9-XXXIX	0-XXVII$^{1.2}$ ($^{1}/_{2}$) * 9-XXII$^{1.2}$ 9-XXXVIII^{1}	9-XXVIII^{1}
to left horizontal	..	..	9-XLV^{1}
Left, from right abdomen. †	..	..	9-XLV^{3} 9-XLVI^{3}
Total......11½ loops, in 9 cases (9½ loops, in 8 cases, from the vertical.)			
Right, from left oblique			
to vertical	..	..	9-XLVI^{1}
to right oblique	9-XLII	0-XXVII^{2} ($^{1}/_{2}$) 9-XXV$^{1.2}$ 9-XXXVIII^{2}	9-XXVIII$^{2.3}$ 9-XLV^{2} 9-XLVI^{2}
to right horizontal	9-XLVIII	9-IX$^{1.2}$	..
Total......12½ loops, in 9 cases (11½ loops, in 9 cases, from the vertical.)			
On a longitudinal axis			
Forward and to the left	..	0-XXVII^{1}	..
Forward, downward and to the left.	..	..	9-XLV^{1}
Forward and to the right	..	9-XXV$^{1.2}$	9-XXVIII$^{2.3}$ 9-XLV$^{2.3}$ 9-XLVI^{2}
Forward, downward and to the right	9-XLVIII	9-IX$^{1.2}$	..
On a transverse axis			
Forward and downward	..	..	9-XLVI^{3}
On an oblique axis			
Forward, downward and to the left	..	..	9-XLV^{1}
Forward, downward and to the right	9-XLVIII	9-IX$^{1.2}$	..

*The number of the loop, whether 1st, 2nd or 3rd, is indicated by small figures (1, 2, 3) above and to the right of the Case number: thus, 0-XXVII^{1} means the 1st loop in that case. Where only one loop exists, no loop number is given; as 0-XL. Where only one limb of a loop rotates ½ is placed in parenthesis after the loop number; thus, 0-XXVII$^{1.2}$ ($^{1}/_{2}$) means the 1st loop and one limb of the 2nd loop.

†"Left from right abdomen" means rotation to the left of a loop lying to the right of the median line, as the 3rd loop in these cases.

TABLE VIII

ROTATION OF LOOPS IN THE THREE TYPES OF SIGMOID COLON AS FOUND BETWEEN THE 4TH AND 8TH FETAL MONTHS: GROUPED ACCORDING TO AXES AND THE DIRECTION OF ROTATION

	1st type (6 cases.)†	2nd type (4 cases)	3rd type (3 cases)
On an antero-posterior axis			
Left, from vertical			
to left oblique.........	8-XLI(½)* 5-XXIX	6-XIV$^{1\cdot2}$ 4-XVII$^{1\cdot2}$	8-XLIV^{1} 7-XLVII^{1} 6-XIX$^{1\cdot2}$
to left horizontal.......	..	6-XLIII^{1}	..
Left, from right abdomen‡........	..	..	7-XLVII^{3} (to left horizontal) 6-XIX$^{2\cdot3}$ (to left oblique)
Total......12½ loops, in 8 cases (9½ loops, in 8 cases, from the vertical)			
Right, from left oblique to vertical	8-XLI(½) 7-XVIII	5-XVI^{1}	..
Right, from vertical			
to right oblique......	..	6-XLIII^{2} 5-XVI^{2}	8-XLIV$^{2\cdot3}$
to right horizontal....	7-XXIV 5-XLIX	..	7-XLVII^{2}
Total......9½ loops, in 8 cases (7 loops, in 6 cases, from the vertical.)			
On a longitudinal axis			
Forward and to the left..........	..	4-XVII^{1}	8-XLIV^{1} 6-XIX^{1}
Forward, to the left and downward to the left horizontal....	..	6-XLIII^{1}	7-XLVII^{3}
Forward, and upward, to the left...	..	6-XLIII^{2}	..
Forward and to the right..........	..	..	8-XLIV$^{2\cdot3}$ 6-XIX^{2}
Forward, to the right and downward to the right horizontal...	7-XXIV 5-XLIX	..	7-XLVII^{2}
On a transverse axis			
Forward and downward..........	..	..	6-XIX^{1}
On an oblique axis			
Forward, downward and to the left	..	6-XLIII^{1}	7-XLVII^{3}
Forward, downward and to the right	7-XXIV 5-XLIX	..	7-XLVII^{2}

*The number of the loop, whether 1st, 2nd or 3rd, is indicated by small figures (1, 2, 3) above and to the right of the Case number; thus, 6-XLIII^{1} means the 1st loop in that case. Where only one loop exists, no loop number is given; as 5-XXIX. Where only one limb of a loop rotates, ½ is placed in parenthesis after the loop number; thus 8-XLI(½) means one limb of the loop.

†One case in this 1st type (4-XXIII) shows the primitive sigmoid colon loop in which no rotation has occurred.

‡"Left, from right abdomen" means rotation to the left of a loop lying to the right of the median line, as the 3rd loop in these cases.

(f) MIGRATIONS AND DISPLACEMENTS OF SIGMOID COLON LOOPS FROM COMBINED ROTATIONS, AS FOUND IN THE THREE TYPES OF SIGMOID COLON. (Plates III, IV; Tables VII, VIII, IX)

As the migrations and displacements of the pelvic-sigmoid colon loops are made up of varying combinations of rotation upon an antero-posterior axis, with considerable additions of rotation upon a longitudinal axis, and with the occasional addition of rotation upon an axis which is transverse[12] or perhaps oblique (to which are added more or less interchangeability and sliding), it seems to be desirable to make here a resume of the combined rotations as they were found in the 3 types of sigmoid colon.

But it should be noted that no characteristic variations or groupings of the above migrations and displacements are noted on the basis of the three types[18]

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[18] (1) *Migrations and Displacements of Sigmoid Colon Loops as Found in the 1st Type of Sigmoid Colon.* (*Plates III, IV; Tables VII, VIII, IX*)

The 5 cases at term of the 1st type (with a possible total of 5 abdominal inverted-U loops) show the primary abdominal inverted-U loop rotated around an antero-posterior axis, to the resting, left oblique position[8] in 3 cases (0-XL, 9-XXXVII, 9-XXXIX); to the right oblique in 1 case (9-XLII); and to the right horizontal in 1 case (9-XLVIII).

This last case shows an added rotation of the loop upon a longitudinal axis, forward, to the right and downward. Or both rotations may be combined and the movement occur upon an oblique axis.

The 6 fetal cases of the 1st type (with a possible total of 6 abdominal inverted-U loops) show the primary abdominal inverted-U loop in the primitive vertical position[9] in 1 case (4-XXIII); while this loop is rotated around an antero-posterior axis to the resting, left oblique position in 1 case (5-XXIX); and the left limb of the loop shows a similar rotation in 1 other case (8-XLI).

It has probably begun reverse rotation to the right, on an antero-posterior axis, arriving at the vertical position, in 1 case (7-XVIII), and in the right limb of the loop, in 1 other case (8-XLI); and it has completed such rotation to the right, reaching the right horizontal position, in 2 cases (7-XXIV, 5-XLIX).

These last 2 cases show an added rotation of the loop upon a longitudinal axis, forward, to the right and downward. Or both rotations may be combined and the movement occur upon an oblique axis.

It is interesting to note that in the fetal group, the 1st type shows no intermediate stages of displacement to the right between the vertical position of the loop and its complete displacement to the right pelvis, *i. e.*, no right oblique positions.

(2) *Migrations and Displacements of Sigmoid Colon Loops as Found in the 2nd Type of Sigmoid Colon.* (*Plates III, IV; Tables VII, VIII, IX*)

The primary resting left oblique positions of the 2 abdominal inverted-U loops, in the 2nd type of sigmoid colon, are noted fairly typically[8] in 1 case (9-XXII); in the 1st loop and the left limb of the 2nd loop in one case (0-XXVII) and in the 1st loop in 1 case (9-XXXVIII).

If these be taken as a standard, one might say that the 5 cases of the 2nd type (with a possible total of 10 abdominal inverted U loops) show 4½ loops in 3 cases, rotated around an antero-posterior axis to the resting, left oblique position—the 1st loop in one of these cases (0-XXVII) has an added rotation, forward and to the left, upon a longitudinal axis.

Rotation to the right on an antero-posterior axis has reached the right oblique in 3½ loops in 3 cases (0-XXVII$^{2\ (1/2)}$, 9-XXV,$^{1.2}$ 9-XXXVIII^{2}); and such rotation to the right has been completed, reaching the right horizontal position in both loops in 1 case (9-IX).

This last case shows, in both loops, an added rotation upon a longitudinal axis, forward, to the right and downward. Or both rotations may be combined and the movement occur upon an oblique axis. And both loops in 1 of the preceding 3 cases (9-XXV) also show some rotation, forward and to the right, upon a longitudinal axis.

While the 4 fetal cases of the 2nd type (with a possible total of 8 abdominal inverted-U loops), show both loops rotated around an antero-posterior axis to the resting, left oblique position[9] in 2 cases (6-XIV, 4-XVII)—the 1st loop in the latter case having an added rotation, forward and to the left, upon a longitudinal axis; and a completion of such rotation to the left, reaching a left horizontal position, in the 1st loop, in 1 other case (6-XLIII)—this latter loop having an added rotation upon a longitudinal axis, forward, to the left and downward.

Rotation to the right, around an antero-posterior axis, has reached the vertical in the 1st loop in 1 case (5-XVI), and it extends to differing degrees of the right oblique position in the 2nd loop of this case (5-XVI) and in the 2nd loop of 1 other case (6-XLIII)—this latter loop having an added rotation upon a longitudinal axis, forward and upward (to the left).[17]

(3) *Migrations and Displacements of Sigmoid Colon Loops as Found in the 3rd Type of Sigmoid Colon.* (*Plates III, IV. Tables VII, VIII, IX*)

The primary resting position of the 3 abdominal inverted-U loops in the 3rd type of sigmoid colon can only be inferred, since these loops were found perhaps undisplaced in only 1 of the 3 cases in which this type was noted, (9-XXVIII)[8]. The position in this case is, therefore, taken as a standard; though, starting from the primitive left pelvic location, this position implies that some rotation to the right, upon an antero-posterior axis, must have already occurred in the 2nd and 3rd loops, the 1st or left loop occupying a similar resting left oblique position to that seen in the other types. (If one should attempt to synthesize the primary, resting position of the 3rd type, taking the observed 1st and 2nd types as a basis, it is difficult to see how any very different position from that found in this 1 case could be assumed by the 3 abdominal inverted-U loops, if undisplaced and if filled with meconium as at term—compare with the displaced loops in the other 2 cases.)

If this case be taken as a standard, one might say that the 3 cases in this 3rd type (with a possible total of 9 abdominal inverted-U loops) show the 1st loop rotated around an antero-posterior axis to the resting, left oblique position,[8] in 1 case (9-XXVIII); and a completion of such rotation to the left, reaching the left horizontal, in 1 other case (9-XLV). This latter loop has an added rotation upon a longitudinal axis, forward, to the left and downward. Or both rotations may be combined and the movement occur upon an oblique axis.

Two other rotations to the left upon an antero-posterior axis were found in 2 cases, these being of the 3rd loop from the right abdomen—a little to the left of the median line (with added rotation to the right upon a longitudinal axis[16] in 1 case 9-XLV); and to the median abdomen (with added rotation forward and downward, upon a transverse axis), in the other case (9-XLVI).

Rotation to the right, upon an antero-posterior axis occurs in 5 loops, in 4 cases—to the vertical, in the 1st loop in 1 case (9-XLVI); and to the right oblique, in the 2nd and 3rd loops, in 1 case (9-XXVIII); and in the 2nd loop in each of 2 other cases (9-XLV, 9-XLVI). 6 loops are rotated upon a longitudinal axis—1 to the left, as noted above; and 1 noted above, as well as 4 others, to the right.

While the 3 fetal cases of the 3rd type (with a possible total of 9 abdominal inverted-U loops) show the 1st loop rotated around an antero-posterior axis to the resting, left oblique position,[9] in 2 cases (8-XLIV, 7-XLVII)—the former having an added rotation on a longitudinal axis, forward and to the left.

In the 3rd case (6-XIX), the 1st loop had evidently undergone a similar rotation to the resting, left oblique position but it then added a rotation forward and downward, upon a transverse axis, as well as a rotation forward and to the left, upon a longitudinal axis. In this case, the 2nd and 3rd loops have probably rotated upon an antero-posterior axis, first to the right, to the right abdomen, and then to the left, to the left abdomen, the 2nd loop having an added rotation, forward and to the right, upon a longitudinal axis.

The 3rd loop, in 1 case (7-XLVII) has undergone complete rotation on an antero-posterior axis, probably from the right abdomen), to the left horizontal, in the middle of the pelvis; and it has an added rotation upon a longitudinal axis, forward, to the left and downward.

Rotation to the right, around an antero-posterior axis, occurs in 3 loops—the 2nd and 3rd loops to the right oblique, in 1 case (8-XLIV), and the 2nd loop to the right horizontal, in 1 case (7-XLVII); all 3 of these loops having an added rotation upon a longitudinal axis, forward and to the right, and the last one also downward. (Alternative minor variations in the detailed steps of migrations and displacements, particularly in the complex 3rd type, may here and there suggest themselves but these do not change the main laws of displacements and retracement of displacements.)

TABLE IX
ROTATIONS OF SIGMOID COLON LOOPS UPON AN ANTERO-POSTERIOR AXIS, AS FOUND IN THE AT TERM AND FETAL GROUPS: GROUPED ACCORDING TO TYPES

	Cases at Term					
	1st loop		2nd loop		3rd loop	
	To left	To right	To left	To right	To left	To right
1st type						
0-XL	lft. obl.	..				
9-XXXVII	lft. obl.	..				
9-XXXIX	lft. obl.	..				
9-XLII	..	rgt. obl.				
9-XLVIII	..	rgt. hor.				
2nd type						
0-XXVII	lft. obl.	..	½ lft. obl.	½ rgt. obl.		
9-IX	..	rgt. hor.	..	rgt. hor.		
9-XXII	lft. obl.	..	lft. obl.	..		
9-XXV	..	rgt. obl.	..	rgt. obl.		
9-XXXVIII	lft. obl.	..	..	rgt. obl.		
3rd type						
9-XXVIII	lft. obl.	..	..	rgt. obl.	..	rgt. obl.
9-XLV	lft. hor.	..	..	rgt. obl.	..	[1]
9-XLVI	[2]	..	..	rgt. obl.	..	[3]

[1] 9-XLV^{3}, probably right to right oblique, then left to left of median line.
[2] 9-XLVI^{1}, probably left to left oblique, then right to vertical.
[3] 9-XLVI^{3}, probably right to right oblique, then left to median abdomen.

	Fetal Cases					
	1st loop		2nd loop		3rd loop	
	To left	To right	To left	To right	To left	To right
1st type						
8-XLI	½ lft. obl.	[1]				
7-XVIII	[2]	..				
7-XXIV	..	rgt. hor.				
5-XXIX	lft. obl.	..				
5-XLIX	..	rgt. hor.				
4-XXIII	[3]					
2nd type						
6-XIV	lft. obl.	..	lft. obl.	..		
6-XLIII	lft. hor.	..	..	rgt. obl.		
5-XVI	[4]	..	..	rgt. obl.		
4-XVII	lft. obl.	..	lft. obl.	..		
3rd type						
8-XLIV	lft. obl.	..	..	rgt. obl.	..	rgt. obl.
7-XLVII	lft. obl.	..	..	rgt. hor.	[5]	..
6-XIX	lft. obl.	..	[6]	..	[6]	..

[1] 8-XLI, right limb probably left to left oblique, then right to vertical.
[2] 7-XVIII, probably left to left oblique, then right to vertical.
[3] 4-XXIII, primary loop in primitive vertical position, no rotation having yet occurred.
[4] 5-XVI^{1}, probably left to left oblique, then right to vertical.
[5] 7-XLVII^{3}, probably right to right oblique, then left to left horizontal to left of median line.
[6] 6-XIX^{2,3}, probably right to right oblique, then left to left oblique.

ANGULATION, KINKING AND TORSION—WITH ESPECIAL REFERENCE TO MECHANICAL OBSTRUCTION AND TO STASIS. (Plates III, IV)

The inverted-U positions of the pelvic-sigmoid colon found predominantly in this study—left oblique, vertical, right oblique—and the migratory powers of these loops, together with their power of interchangeability, are admirably adapted to the reduction to a minimum of mechanical obstruction to the passage of its contents onward towards the rectum.

But kinking is always possible at the ends of the limbs of any form of U-loop, and this possibility is increased in proportion to the degree of angulation existing between the ends of the limbs and the adjacent portions of the intestine. Interchangeability may diminish the degree of this angulation. Fixation of one or both limbs of the loops interferes with the action of interchangeability, and so increases the tendency to the development of obstruction from angulation or kinking.

In the positions mentioned above, the mechanical possibilities of obstruction are greatest at the junction of the movable pelvic-sigmoid colon with the fixed iliac-sigmoid colon, *i. e.*, in the neighborhood of the left psoas muscle, at the brim of the pelvis.

This danger may be said to be from without, but a predisposing danger from within may be present at the junction of the movable pelvic-sigmoid colon with the fixed rectum, *i. e.*, in the neighborhood of the 3rd sacral vertebra. Here, according to some anatomists, the sigmoid-rectum junction is marked by a contraction which more or less diminishes the calibre of the intestine at this point.[19] In such case, a slight angulation might produce more tendency to obstruction than a greater degree of angulation in the absence of the limiting contraction.

Mechanical obstruction, then, is always potential at the left or psoas end of the pelvic-sigmoid colon, in the left lower quadrant of the abdomen, because angulation always tends to be present here, at the junction of the pelvic-sigmoid colon inverted-U loop and the iliac-sigmoid colon. This angulation is absent in only 2 of 13 cases At Term (9-IX, 9-XLVIII), and in only 3 of the 13 fetal cases (7-XXIV, 6-XIX, 5-XLIX).

This tendency to angulation depends on 4 factors: (a) That the pelvic-sigmoid colon tends to follow the line of the parietal attachment of its meso, thus forming an inverted-U, the junction of this inverted-U with the iliac-sigmoid colon forming an angle (which may be sharp or rounded) opening upward; (b) that the pelvic-sigmoid meso is only beginning at this point of junction; (c) that though the pelvic-sigmoid colon is mobile, the iliac-sigmoid colon is fixed; and (d) that the primary, resting, left oblique inverted-U position which the pelvic-sigmoid colon tends to assume, and to which it tends to return after migration or displacement, favors angulation at this point.

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[19] A thick narrow constriction at the sigmoid-rectum junction was noted in 1 of the 15 cases at term (9-IX). A similar contraction was noted at the junction of the pelvic-sigmoid colon with the iliac-sigmoid colon; and a third at about the middle of the course of the pelvic-sigmoid colon. These contractions appeared to be pathologic and not of the nature of the anatomic one quoted above.

Angulation or kinking at the left or psoas end of the pelvic-sigmoid colon, diminishes as rotation of the 1st or primary inverted-U loop on an antero-posterior axis progresses to the right. This is seen in varying degrees in 6 cases at term (9-XXV, 9-XXVIII, 9-XXXVIII, 9-XXXIX, 9-XLII, 9-XLVI), and in 2 fetal cases (7-XVIII, 5-XVI).

But angulation at this point becomes more acute, and the tendency to obstruction is proportionately increased as this loop rotates on an antero-posterior axis to the left, especially if a downward movement be added: this is seen in varying degrees in 4 cases at term (0-XXVII, 0-XL, 9-XXII, 9-XXXVII), and in 6 fetal cases (8-XLI, 8-XLIV, 7-XLVII, 6-XLII, 5-XXIX, 4-XVII).

However, as rotation to the left and downward on an antero-posterior axis becomes more marked and this loop approaches the horizontal position, rotation forward and downward on a longitudinal axis may be added, converting the oblique inverted-U loop into a horizontal-U, the former median limb of the loop swinging forward and becoming now the anterior limb. This longitudinal rotation favors resumption of the rotation downward on an antero-posterior axis, and in proportion as this latter rotation now progresses, it opens the angle (which now opens outward instead of upward) and so diminishes the angulation, rounding it or moving it farther along the movable portion of the tube, thus tending to lessen the obstruction. This condition is noted in 1 case at term (9-XLV) and in 1 fetal case (6-XLIII).

Owing to the anatomic course of the distal part of the sigmoid colon and its meso, angulation or kinking at the left side of the right or sacral end of the pelvic-sigmoid colon is not likely to be caused by such rotation to the left; this is well illustrated in 3 cases at term (0-XL, 9-XXII, 9-XXXVII) and in 3 fetal cases (8-XLI, 7-XVIII, 5-XXIX).

Extreme rotation to the left, as to the above left horizontal position, is not noted in the 1st loop in any case where that is the only loop existing. However, were such complete rotation to take place in the primary loop of cases of the 1st type, as occur in this loop in the 2nd or 3rd type (6-XLIII, 9-XLV), more or less tendency to angulation and kinking might occur at the left side of the sacral end, near the sigmoid-rectum junction.

Conditions favoring mechanical obstruction sometimes develop at the right, or sacral, or rectal, end of the sigmoid colon, as the result of angulation, with or without torsion, produced by the migrations and displacements heretofore described.

Angulation or kinking is not seen to develop at this right or sacral end of the pelvic-sigmoid colon under rotation of the terminal loop upon an antero-posterior axis alone. The most marked extension of this rotation alone which is seen does not develop even a right angle, inferiorly, at the sacral end of the sigmoid colon (9-XXII, 6-XLIII).

The essential factor for angulation at this right or sacral end seems to be downward displacement (or descent) of the terminal pelvic-sigmoid colon in such a way as to make an angle, opening downward, at the junction of a more mobile tube (the more proximal sigmoid colon) with a more fixed tube (the terminal sigmoid colon, or the rectum[20]). This displacement may be to the right or to the left, and forward. It was seen to the right in 4 cases at term (9-IX, 9-XLV, 9-XLVI, 9-XLVIII) and in 2 fetal cases (7-XXIV, 5-XLIX); and to the left in 1 fetal case (7-XLVII^3—compare 7-XLVII^2), and it was suggested in 1 other (8-XLIV)

On the left side of this sacral end, the study of this last fetal case (8-XLIV) suggests that in the terminal loop simple though extreme descent alone (of the terminal inverted-U and the U which connects this with the more proximal inverted-U) may produce angulation; while another fetal case (7-XLVII) shows such angulation resulting from rotation to the left upon an antero-posterior axis, to which is added rotation forward and downward upon a longitudinal axis; the left horizontal-U thus formed lying just to the left of the median line, near the level of the sigmoid-rectum junction. In this latter case, the angulation is accompanied by a beginning torsion.

On the right side of this sacral end, descent alone has not developed the angle. It has been developed (2 cases at term—9-IX, 9-XLVIII; 2 fetal cases—7-XXIV, 5-XLIX) by rotation of the terminal loop to the right, upon an antero-posterior axis, plus forward and downward rotation upon a longitudinal axis, resulting in a right horizontal-U in the right lower quadrant or iliac fossa, these cases showing also the beginning of torsion. It has also been developed (1 case at term—9-XLVI) by forward and downward rotation, in the median line, one half turn, upon a transverse axis; and (in 1 case at term, 9-XLV) by marked descent in the right abdomen, plus rotation to the right upon a longitudinal axis.

From the foregoing study, it appears that a similar rotation acts differently in the left and in the right abdomen.

Thus, it is to be noted that in both the left and right abdomen, a certain degree of rotation upon an antero-posterior axis to the left and downward and to the right and downward, respectively, may be followed by rotation forward and downward upon a longitudinal axis. This similar rotation of the pelvic-sigmoid colon in the left and right abdomen is followed by dissimilar results in angulation and in the possibilities of kinking and mechanical obstruction.

In the left abdomen, the added forward and downward rotation on a longitudinal axis tends to diminish the angulation already existing at the psoas end of the pelvic-sigmoid colon; on the other hand, in the right abdomen, the added forward and downward rotation on a longitudinal axis tends to develop an angulation at the sacral end of the pelvic-sigmoid colon.

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[20] Angulation at the terminal end of the sigmoid colon may occur proximal to the exact sigmoid-rectum junction, depending upon the rapidity with which the terminal sigmoid meso becomes reduced in depth, the descent of the terminal sigmoid colon being favored or limited by the varying depth of the terminal sigmoid meso.

Again, while in both the left and right abdomen, the added forward and downward rotation on a longitudinal axis favors the resumption of the downward rotation of the loop upon an antero-posterior axis, such latter rotation in the left abdomen, tends to diminished angulation at the psoas end of the pelvic-sigmoid colon by increasing the angle, this angle opening upward. But such latter rotation in the right abdomen, tends to increased angulation at the sacral end of the pelvic-sigmoid colon by diminishing the angle, this angle opening downward.

In both the left and right abdomen, the former median limbs of the loops have now become the anterior or lower limbs and these limbs,other things being equal, have greater possibilities of descent than have the upper or posterior limbs which are held at their bases, where they help to form the angles, by the diminishing meso.

And it is through these more movable anterior limbs that, by interchangeability, the angle may be moved along and opened or enlarged. On the left side, this would result in the angle moving downward (and opening more outward), as has been noted; but on the right side, the angle would have to move upward to open, and this latter is probably more difficult, no transitional position suggesting it having been found.

To sum up: Both the beginning and the terminal ends of the mobile pelvic-sigmoid colon may descend and may thus develop or increase angles with an adjacent fixed portion of intestine. The apparently contradictory results in the two sides of the abdomen are due to difference in the formation of the angles. The angle near the beginning, in the left abdomen, is an upward-opening one; that near the end, in the right (or median) abdomen, is a downward-opening one. In the left abdomen, the mobile descending part tends first to move towards the fixed part, thus making the angle more acute and increasing the angulation; continuing its descent, it then tends to pass away from the fixed part, thus moving towards opening the upward-directed angle, making it less acute, and so decreasing the angulation.

While, in the right abdomen, the descending part tends constantly to pass towards the fixed part, thus moving towards developing and making more acute the downward-directed angle, and so increasing the angulation.

Rotation around a longitudinal axis leads towards torsion, this moving toward obstruction in proportion as the ends of one or both limbs of the loop are sufficiently fixed: this rotation is seen in 4 cases at term (9-IX^2, 9-XLV^3, 9-XLVI^3, 9-XLVIII) and in 5 fetal cases (7-XXIV, 7-XLVII^{2,3}, 6-XIX^1, 6-XLIII^2, 5-XLIX).

Rotation upon a transverse axis leads toward inversion and the development of a U-loop; and this tends to develop angulation or kinking in proportion as the bases of the limbs are, or become, fixed. The acuteness of the angulation or kinking diminishes as the transverse rotation is less complete[12]. This rotation is seen in 1 case at term (9-XLVI^3) and in 1 fetal case—no angulation but beginning torsion occurring in the latter (6-XIX^{1}).

Rotation around an oblique axis, being a combination of rotation around an antero-posterior and a longitudinal axis, has the same tendency as these forms of rotation, and tends towards the development of both angulation and torsion. It occurs to the right in 5 cases (2 at term—9-IX^{2}, 9-XLVIII; 3 fetal cases—7-XXIV, 7-XLVII^{2}, 5-XLIX), and to the left in 3 cases (1 at term—9-XLV^{1}; 2 fetal cases—7-XLVII^{3}, 6-XLIII^{1}).

Thus, angulation or kinking may follow rotation upon an antero-posterior, a longitudinal or a transverse axis but torsion seems to require rotation upon a longitudinal axis—rotation upon an oblique axis being a combination of rotation upon at least two of these three axes, may cause both angulation or kinking and torsion.

But the angulation, kinking or torsion, however developed, may not be followed by definite obstruction (though it must, mechanically, lead toward stasis) if the compensatory power of interchangeability be not impaired—this factor moving towards compensatory displacement of the involved and adjacent parts of the mobile portion of the intestine.

The presence of relative or actual fixation of some portion of the loop impairs the action of this interchangeability and so may lead toward the development of obstruction. But even actual pathologic fixation may be compensated for, as demonstrated in 1 of the at term cases (9-XLVI^{1,2}). Here, widening of the base of the connecting U-loop, with rotation of this loop forward and upward upon a more or less transverse axis, is shown compensating for the tendency to angulation induced by the pathologic fixation of the apices of the 1st and 2nd inverted-U loops.

The foregoing study refers to the sigmoid colon tube but it must be remembered that movements of this tube affect also the sigmoid meso.

And it must further be remembered that both borders of this meso are attached—the visceral border being as long as the sigmoid colon itself but the parietal border being always limited to the length of its attachment to the posterior pelvic and abdominal wall, *i. e.*, from the left psoas muscle at the brim of the pelvis, obliquely upward and inward to the 3rd or 4th lumbar vertebra, then vertically downward to the neighborhood of the 3rd sacral vertebra.

The depth of this meso is considerable, allowing the free movement of the attached colon over the abdomen as already described. Nevertheless, as the colon undergoes its various migrations or displacements, it is followed through these migrations or displacements by related movements of its meso, and the effect of these migrations or displacements upon the meso, and upon its nerves and its blood and lymph channels, must be considered—angulation, kinking and torsion of these structures also occurring, and more rapidly in proportion to diminution in the depth of the portion of meso involved.

Probably pressure on these nerves and on these blood and lymph channels are factors in arousing reflexes which tend to relieve pressure or tension upon them, as well as upon the intestinal tube nerves and its blood and lymph channels, muscles and other structures.

No definite pathologic volvulus was seen in any of the cases here detailed but the initial anatomic and physiologic paths which might lead to its development are shown in this study of rotations, angulations and torsion—movements and displacements which evidently occur continually in response to normal reflex stimuli. Other stimuli and reflexes are added by postnatal environment, and these will be discussed in a later section (Section III).

DISTENSION (DILATATION?): DAMMING BACK OF MECONIUM, WITH DISTENSION OF THE PROXIMALLY ADJACENT INTESTINE

In 25 out of 28 cases (14 out of 15 at term; 11 out of 13 fetal cases), the sigmoid colon was found notably large and filled with meconium, and in 8 of the at term cases and in 1 fetal case (5-XXIX), it was noted as being "distended". The normal limits of such distension are not known but in at least 1 of the above 9 cases, it is strongly suggested that these limits have been passed and that a state of "dilatation" exists (0-XL).

In 9 of the 25 cases, limits of distensibility of the sigmoid colon were apparently reached, since meconium was found apparently dammed back —into the markedly distended descending colon, in all 9 cases, and also into the markedly distended transverse colon, in 3 of these 9 cases; while in 2 of these 3 cases and in 2 others, the ileum also was markedly distended, and it contained meconium; and in 1 of the former 2 cases, the stomach also contained meconium.

All types shared in this distention and damming back, there being 4 cases of the 1st type, 4 of the 2nd, 1 of the 3rd, and 1 of either the 2nd or 3rd, while in the 1 remaining case, the type was not noted.

TABLE X

Type	Case Nos.	Distension of the Sigmoid Colon: apparent damming back of meconium into proximal portions of the intestine				
2nd	0-XXVII	Sigmoid	Descending	Subgastric transverse	Ileum	
1st	0-XL	Sigmoid	Descending	All of transverse	Ileum	Stomach
2nd or 3rd	9-XII	Sigmoid	Descending			
2nd	9-XV	Sigmoid	Descending			
3rd	9-XXVIII	Sigmoid	Descending			
1st	9-XXXVII	Sigmoid	Lower descending		Ileum	
2nd	9-XXXVIII	Sigmoid	Descending	Subgastric transverse loop		
1st	9-XLVIII	Sigmoid	Descending			
1st	5-XXIX	Sigmoid	Descending			
Not noted	5-XI*	..	..	..	Ileum	
2nd	4-XVII*	..	..	..	Ileum	

*In 5-XI, the whole colon is about the size of the upper small intestine; a coil of the ileum is dilated and it contains meconium. In 4-XVII, the sigmoid colon and the rectum were found empty; there were traces of meconium in the cecum and here and there along the colon, and coils of ileum were filled with it.

Longitudinal Muscle Bands

In 1 of the 28 prenatal cases (1 out of 15 at term), longitudinal muscle bands were noted as being absent in the sigmoid colon (9-XLII).

Sacculations. (Plates III, IV)

In only 1 of the 28 prenatal cases (1 at term—9-XLV) were sacculations found in the sigmoid colon; and in this case, they were noted as "distinctly seen, except in an area measuring 55 mm. in length, where there is no trace of them," though the longitudinal muscle bands were present throughout. In 2 other cases (9-XLVIII, 5-XXIX), there were slightly marked furrows, indicating the beginning of sacculation, present in different parts of the colon. In 3 other cases, it is noted that these suggestions of sacculations were noted in other parts of the colon—in the ascending and transverse colons only, in 9-XLVI; in the transverse colon, in 7-XLVII; and in the transverse and descending colons, in 5-XLIX.

The slightly-marked furrows which suggested the beginning of sacculations were always found to follow the course of the blood vessels which run from the meso over the colon, taking a course at right angles with the long axis of the tube. These furrows were deepest at the mesenteric border and grew rapidly shallower towards the free border of the intestine. Not all blood vessels lay in furrows but all the furrows contained blood vessels.

Similar but very much slighter puckerings were observed in the small intestine; and here, again, the puckerings were found to follow the course of the blood vessels over the intestine, at right angles to the long axis of the latter.

Hence, it would appear that in the presence of common contractile conditions, the increased localized resistance offered by the larger vessel and nerve trunks (and especially by the positive centrifugal pressure of the arterial current[21]) as they pass from the mesentery and lie on the intestinal wall, might determine in both small and large intestines such slight linear recessions as are commonly designated as puckerings or beginning furrows.

But the large intestine has a contractile tissue additional to that which it possesses in common with the small intestine (the longitudinal muscular coat), this added contractile tissue being the longitudinal muscle bands characteristic of this portion of the intestinal tube. (The observation noted above shows that in rare instances, these bands may be absent).

If, as the morphology would suggest, the large intestine contracts more definitely and powerfully along the three, or two, lines of the longitudinal muscle bands, this would make for a shortening of the tube along these bands, the less contractile portion of the tube between these bands remaining relatively redundant and flaccid, and tending to fall within or protrude beyond the plane of the bands, according as the intra-intestinal pressure is minus or plus.

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[21] This centrifugal tendency of the force of the arterial current (or sometimes of the venous) is seen in the grooving of even so resistant a tissue as bone, in many locations in the body.

Postnatal observation shows that the large intestine does shorten along the lines of the longitudinal muscle bands; hence, the fundamental factor in the formation of sacculations must be the longitudinal muscle bands. This observation may explain why when sacculation is well established, it is less marked in the sigmoid than in other portions of the colon, this part of the colon having only two longitudinal muscle bands, while the other portions have three.

But postnatal anatomic observation also shows that the less contractile portion of the tube between the bands neither falls within nor protrudes beyond the plane of the bands in an erratic way but that it falls within the plane of these bands in a somewhat definite linear manner, and at rather definite intervals. And that only between the depressed lines (or furrows) where this definite falling within occurs, does the intestinal wall remain relatively redundant and flaccid, forming pouches, or saccules, the walls of which tend to fall within or protrude beyond the plane of the bands, according as the intra-intestinal pressure is minus or plus.

From these postnatal anatomic observations, it would appear that the determining factors in causing the sacculations characteristic of the large intestine are (1) shortening of the tube, due to longitudinal muscle bands; and (2) the transverse infolding of the intestinal wall at rather definite, though irregular intervals.

And the observations and experiments of the writer would suggest that the location of these transverse infoldings is determined by a localized increased centripetal tendency of the intestinal wall due to the presence of the larger intestinal vascular and nerve branches, as they pass over the tube from the mesentery, and especially to the positive centrifugal pressure of the arterial current; this intestinal centripetal tendency and positive centrifugal arterial pressure finding counter-pressure or counter-resistance through the contracting longitudinal muscle bands.

Experiment I.

See Experiment I detailed under Location of the Sigmoid Colon Formations, showing the lessening of redundancy and the "gathering" or "fulling-up" of the intestinal tube which result from its being shortened, causing multitudinous puckerings and foldings of the wall, and the formation of irregular saccules or pouches.

Experiment II.

If the shortening of the string in Experiment I be done very slowly, the tendency of the sigmoid colon to pucker is first indicated by the falling in of the flaccid wall of the tube where the larger blood vessels lie across it as they come from the meso (and where there is already a suggestion of puckering). This experiment must be performed very carefully.

Experiment III.

Owing to the curving course of the sigmoid colon, this experiment is made with fewer complications if one uses a limited portion of the tube which can be maintained in a straight position.

Then, after making the end of the string fast on the crest of the ilium, it is inserted through the wall at one end of the straight portion and brought out at the other end of this portion. In this manner, the changes can be induced more gradually and their effect noted more definitely.

The best results are obtained when the section of intestine is filled with liquid or semi-liquid contents (meconium, boiled starch, etc.) which can be retained under a medium tension—not so high as to offer too great resistance, and not so low as to permit of irregular collapse of the walls. But the greater the density of the contents, the less likely are these latter to escape by the side of the string.

Experiment IV.

Similar experiments in the ascending, transverse and descending colons give similar results, though they seem most definite in the transverse colon.

Experiment V.

A pin is inserted in the lower end of the gladiolus or in the left costal arch, for the attachment of a string, the free end of which is passed through differing sections of the jejuno-ileum, and the string is then shortened as in the preceding experiments.

This experiment is more difficult to interpret because of the changing course of the small intestine, due to the redundancy of the visceral as compared with the parietal border of the mesentery. But it can be performed on very small sections, and the results are similar to those noted in the colon.

Experiment VI.

The above experiments were repeated after injecting and tying off the main arterial trunks. Results were similar to those already noted, but more marked.

Experiment VII.

A "gathering" thread was passed through the length of the longitudinal muscle band nearest the mesenteric border, and the line of this longitudinal muscle band was then shortened by traction. The result seemed to emphasize the tendency of the intestinal wall to fall in most markedly in the line of the larger vessels crossing it from the meso. It also showed a marked deepening of the furrows and their extension from the mesenteric border towards the longitudinal muscle bands. From these shortening bands, secondary furrows started irregularly, some of the latter tending to meet the furrows advancing in the line of the transverse arterial branches.

The aforementioned view of the writer is quite in harmony with the general absence of sacculations in prenatal life, and their well-developed presence in post-natal life.

In prenatal life, the large intestine, and especially the sigmoid colon, is pre-eminently a reservoir for the accumulation of waste. As soon as the child is born, the scene is transformed; the reservoir moves to empty itself; and among other active agents invoked, the longitudinal muscle bands of the colon must be called upon for their share of help in propulsion of the contents distally. Coincident with, or precedent to, these muscular activities, the volume of the arteries of the tract is increased proportionately to the demands of its increased functioning. Thus, both of the determining activities mentioned above become active at birth, and remain in continuing activity. In one case studied by the writer, which was born at term and lived for two months, sacculations were noted as being well-marked throughout the colon.

In the previous section (Distension and dilatation of the sigmoid colon), it has appeared evident that even though a closed reservoir, the colon is throughout prenatal life more or less active in propelling its contents towards the terminal orifice. And individual and regional variations in this activity, and the results of this activity, are demonstrated. It seems reasonable to infer that the suggestions of beginning sacculations noted above are additional evidence of these individual and regional variations in colon activity.

THE SIGMOID MESO: ITS OCCURRENCE; DEPTH; ADHESION; DIFFERENTIATION

The redundancy of the sigmoid colon is correlated with redundancy of the visceral border of the sigmoid meso.

In 28 cases (15 at term; 13 fetal cases), the pelvic-sigmoid meso was always present, varying in depth from a few mm. to 65 mm.

Its maximum depth from parietal to visceral attachment varied, in 7 records at term, from 20 to 65 mm.; and in 8 fetal records, from 4 to 32 mm. This maximum depth tended to correspond with the highest point of insertion, upon the lower lumbar vertebrae, though sometimes it was found below and, again, to the left of this region. And in 1 case (8-XLIV), it was found over the psoas muscle (in this case, the descending, the iliac-sigmoid and the pelvic-sigmoid mesos are not differentiated from each other at the usual points of limitation).

In the left iliac fossa, there was usually no meso, the meso proper beginning at the left psoas, at the brim of the pelvis. Some exceptions are noted. In 2 cases at term (9-XLV, 9-XLVIII) and in 5 fetal cases (8-XLI, 8-XLIV, 7-XLVII, 6-XIX, 5-XVI), there was a meso in the left iliac fossa; in 6 of these 7 cases (2 at term, 4 fetal cases—all of the foregoing except 6-XIX), the sigmoid mesos and the descending mesos were continuous at the crest of the left ilium; and in 2 of these 6 cases (9-XLVIII, 8-XLIV), the iliac portion of the sigmoid meso was continuous with that of the pelvic portion—hence, in these 2 cases, the descending, the iliac-sigmoid and the pelvic-sigmoid mesos were all more or less continuous. In the remaining 1 of the 7 cases (6-XIX), the iliac-sigmoid and the pelvic-sigmoid mesos were continuous, the two not being differentiated by adhesion at the left psoas at the brim of the pelvis.

For experimental relations of the unfolded meso to formations, see Experiment 1.

ANATOMIC VARIATIONS NOTED.

Anatomic variations exist in practically every detail of the sigmoid: The greatest uniformity was noted in—

- the existence of redundancy, with the formation of loops, which arrange themselves according to three types and extend over the abdomen (15 out of 15 at term; 13 out of 13 fetal cases):

the disproportionately large calibre as compared with other divisions of the colon (15 out of 15 at term; 12 out of 13 fetal cases), and the distension with meconium (14 out of 15 at term; 12 out of 13 fetal cases):

the location of at least 1 inverted-U loop in the left abdomen (9 out of 13 at term; 11 out of 13 fetal cases):

the passing of the sigmoid colon at term from the right to make its final descent into the pelvis (9 out of 13); and in the fetal cases, from the left (8 out of 13):

its termination in the median line of the pelvis (14 out of 15 at term; 13 out of 13 fetal cases):

the absence of secondary fixed loops formed by the sigmoid colon alone (15 out of 15 at term; 13 out of 13 fetal cases):

the presence of the longitudinal muscle bands (14 out of 15 at term; 13 out of 13 fetal cases):

the practical absence of sacculations (sacculation being only beginning):

the parietal attachment of the pelvic-sigmoid meso (complete in 14 out of 15 at term; 11 out of 13 fetal cases):

the adhesion of the iliac-sigmoid meso in the left iliac fossa (complete in 13 out of 15 at term; 8 out of 13 fetal cases):

the differentiation of the sigmoid meso from the descending meso at the crest of the left ilium (13 out of 15 at term; 9 out of 13 fetal cases):

the differentiation of the iliac-sigmoid meso from the pelvic-sigmoid meso at the left psoas muscle, at the brim of the pelvis (14 out of 15 at term; 11 out of 13 fetal cases).

Pathologic Variations Noted

Pathologic variations, or possibilities, are noted in the direction of—distention (dilatation?) (8 out of 15 cases at term; 1 out of 13 fetal cases): contraction (localized, in 1 case at term, 9-IX; diffused, in one fetal case, 5-XI): fixation of loops by pathologic adhesions (parts of 2 loops in 1 case at term, 9-XLVI$^{1 \cdot 2}$): and kinking and beginning torsion (suggested in many cases in both the at term and the fetal groups).

SUMMARY

1. The writer hopes to demonstrate anatomically and experimentally the conclusions which she has drawn from clinical observations, and which she has already published[1], *i. e.*, that the fundamental cause of visceral ptosis is abdominal incompetence and that this is a developmental factor; that, consequently, the retention of the viscera in their normal positions depends upon the development of normal competence of the abdomen; and that failures in the normal development of this abdominal

competence and visceral retention are correlated with the development of certain departures from the normal body form—the most constant of these departures being the retracted lower thorax.

So frequently do variations in details occur in "normal" viscera that the first step is an attempt to average certain of these variations so as to find an anatomic mean which shall serve as a workable basis for the introduction and interpretation of experiments which exemplify variations in the above-mentioned developmental processes ("normal," or retarded, or uncompleted, or reversive). These developmental processes and their variations may be observed in continual operation in all human beings, and the pictorial and plastic history of the race shows them to have been occurring ever since such history began—a fact to which the writer has previously drawn attention.[1]

2. Individual variations in the location of the lower borders of both lobes of the liver and in the distance below the gladiolus of the median fissure, are found at all ages from at least the 4th month onward. The locations found predominating at term are also found in early fetal ages, and locations predominating in early fetal ages are also found persisting at term.

3. The most striking characteristics of the prenatal sigmoid colon are its disproportionately large calibre, as compared with the other divisions of the colon; its distention with meconium; its extension over the abdomen in redundant loops; and its practical absence of sacculations.

4. The sigmoid colon is found located along four definite lines:—(a) Left iliac fossa, hypogastrium (behind the bladder), and ascending more or less in the left pelvic or suprapelvic abdomen; (b) Left iliac fossa, hypogastrium, and ascending in the left, and thence to the right, abdomen; (c) Left iliac fossa, hypogastrium, and more or less in the right lower quadrant without ascending in the abdomen; (d) Left iliac fossa, hypogastrium, and ascending into the right suprapelvic abdomen, impinging more or less on the right iliac fossa.

Only one of these four lines (a) is primary, the other three being derivatives of this, through increased redundancy or displacement, or both.

5. Great individual variations exist in the length of the sigmoid colon and in the depth of its loops, at term and throughout fetal life. Apart from individual anatomic variation, considerable functional variation in the width exists at term, and even in fetal life; but a tendency to over-distention is a feature of the at term period.

6. Preliminary to its final descent in the median line, the sigmoid colon enters the pelvis from the left (the predominant arrangement in fetal life) or from the right (the predominant arrangement at term), according as its movable preterminal part lies to the left or to the right of the median line. But this preterminal part may change its position from one side to the other in the same patient, at different times and under

different circumstances, the sigmoid colon thus entering the pelvis now from one side and again from the other.

7. To the right of the psoas muscle, the sigmoid colon (pelvic-sigmoid) forms one or more inverted-U loops or coils which tend to pass upward in the abdomen. The primary direction of these loops appears to be upward, in the left pelvic abdomen; one or two secondary loops may be placed to the right of the primary abdominal loop, and so tend to pass successively into the median and the right abdomen. In no case examined by the writer were more than 3 abdominal inverted-U loops observed.

In all these arrangements, one or more of the loops may become displaced but their formation can be traced along these lines.

8. The loop formations of the sigmoid colon show individual variations which exist at all prenatal ages from at least the 4th month onward to term, and which tend to the evolution of 3 types of sigmoid colon, according as 1, 2 or 3 inverted-U loops tend to project themselves upward into the left, left and median, or left, median and right abdomen.

The inverted-U form of the loops is determined primarily by the parietal attachment of the pelvic-sigmoid meso, this line of attachment making an inverted-U (or V), with an oblique external limb, a vertical median limb and an apex directed upward.

The abdominal inverted-U loops may become more or less displaced, so that the type is obscured, but these displacements follow definite paths and by returning displaced loops along the reverse of these paths, the original type may be disclosed and the case so classified. The classification as to type is important, because a lack of knowledge of type leads to confusion in studying both the prenatal and the postnatal evolution of the sigmoid colon.

Great individual variations in the loops occur at all prenatal ages. These variations are not chaotic or anarchic but develop along definite lines from a constant unit, the essential factor in the individual variation being a varying redundancy in this portion of the colon.

9. Redundancy of the sigmoid colon to the right of the left psoas muscle (pelvic-sigmoid), so that its length exceeds the length of the parietal attachment of its meso, is a uniform prenatal development from at least the 4th month onward to term.

The redundancy tends, at all ages from at least the 4th month, to the development of formations which strike the eye of the observer.

The dominant formation of the 1st type of sigmoid colon is the abdominal inverted-U; and the dominant formations of the 2nd and 3rd types are respectively, 2 and 3 abdominal inverted-U's. Secondary formations are produced by the union of these abdominal inverted-U's with the iliac-sigmoid colon and with each other. These secondary formations are U's, M's W's and (horizontal or oblique) S's and reversed S's.

Modifications of the typical formations are constantly occurring, through migrations or displacements of loops, causing variation in the number and kind of the actually-found loops or formations, but by applying the rules noted above (and later), the actually found loops and formations may, if displaced, be retraced to the typical ones, with identification of the original type of sigmoid colon.

10. In attempting to ascertain the location of the sigmoid colon and its formations, one must consider three factors—the individual type; the question of displaced loops; and the age of the child, this latter being relatively more important as term is approached.

And experimental evidence shows modifications caused by variations in the depth of the meso from parietal to visceral attachment; in the extent to which the depth of the meso is unfolded; and in shortening of the tube, as by the development of sacculations.

But the pelvic-sigmoid colon has two constant locations, and these give the key to the surgical landmarks for identifying and tracing it under all circumstances.

11. The observations on the liver and sigmoid colon here noted are suggestive, but a larger number is needed to demonstrate whether there be any direct interrelation between the two viscera, so that it may or may not be something more than a coincidence that the recession of the left lobe of the liver continues till this lobe escapes from the restless region of the redundant loops of the sigmoid colon and the other hollow viscera of the left abdomen.

12. It is desirable to call attention to the varied combination of redundant colon loops (sigmoid colon, subgastric transverse colon and sometimes descending colon) which one may expect to find in the left abdomen, at all prenatal ages from at least the 4th month onward.

13. The pelvic-sigmoid colon as a whole forms one large basal fixed loop whose points of attachment are of least depth at the beginning and terminal ends of its meso, *i. e.*, at the left psoas muscle, at the brim of the pelvis; and in the neighborhood of the 3rd sacral vertebra.

This basic pelvic-sigmoid colon fixed loop may form one primary loop which, following the shape of the parietal attachment of its meso, makes an inverted-U, or, according to its redundancy, it may form a 2nd or a 3rd inverted-U loop to the right of the primary one. But no secondary fixed bases have been observed, all the loops being interchangeable and capable of conversion into the one which consists of the whole pelvic-sigmoid colon.

14. Migrations and displacements of the sigmoid colon loops are constantly occurring, and along similar paths, throughout prenatal life, from at least the 4th month of fetal life to term.

As the common primary base of the sigmoid colon loops (the parietal attachment of the sigmoid meso) is fixed, all migrations or displacements occur by virtue of the rotation of the loops upon a series of axes—antero-posterior, longitudinal, transverse, oblique—movements occurring on these axes either singly or in combination.

Minor displacements may take place as the result of interchangeability and sliding, these latter occurring with or without the addition of the rotations just mentioned.

The basal primitive position of the primary sigmoid colon inverted-U loop is vertical, in the left pelvic abdomen, this loop showing no rotation. As the sigmoid colon increases in size (from age and other factors), the larger abdominal inverted-U loop tends to leave the vertical position and to rotate to the left or to the right, soon adding a downward movement, the left oblique position suggesting itself as a primary resting position for at least the primary, or first, loop.

15. The inverted-U positions of the pelvic-sigmoid colon found predominantly in this study—left oblique, vertical, right oblique—and the migratory powers of these loops, together with their power of interchangeability, are admirably adapted to the reduction to a minimum of mechanical obstruction to the passage of its contents onward towards the rectum.

But mechanical obstruction is always potential at its left or psoas end, in the left lower quadrant of the abdomen, because angulation always tends to be present here (in an upward-opening angle, at the junction of the mobile pelvic-sigmoid colon inverted-U loop and the fixed iliac-sigmoid colon, and at the beginning of the pelvic-sigmoid meso), especially when the resting, left oblique position of the primary, or 1st, loop is developed.

And conditions favoring mechanical obstruction sometimes develop at the right or sacral end of the sigmoid colon, as the result of angulation produced by the migrations and displacements heretofore described.

Angulation in this latter region depends upon the development of a downward-opening angle between the more mobile portion of the terminal sigmoid colon and its more fixed portion (or perhaps the rectum), at the termination of the sigmoid meso (at, or proximal to, the sigmoid-rectum junction).

But angulation, kinking or torsion, however developed, may not be followed by definite obstruction (though it must, mechanically, lead toward stasis) if the compensatory power of interchangeability be not impaired—this factor moving toward compensatory displacement of the involved and adjacent parts of the mobile portion of the intestine.

As the sigmoid colon tube undergoes its various migrations and displacements, it is followed by related movements of its meso. And the effect of these migrations or displacements upon the meso, and upon its nerves and its blood and lymph channels must be considered—angulation, kinking and torsion of these structures also occurring, and more rapidly in proportion to the decreased depth of the portion of meso involved.

No definite pathologic volvulus was seen in any of the cases here detailed but the initial anatomic and physiologic paths which might lead to its development are shown in this study of rotations, angulations and torsion—movements and displacements which evidently occur continually in response to normal reflex stimuli.

16. Distention of the sigmoid colon with meconium is the usual feature at term.

When this distention reaches a certain degree, it seems to lead to damming back of the meconium into the proximally continuous portion of the intestine—the descending colon and, thence, the transverse colon, even up to marked distention of these portions. Rarely, even when these latter distentions are excessive, the continuing pressure towards the sigmoid colon may lead to a condition of apparent (or real) dilatation.

17. The longitudinal muscle bands may occasionally be absent in at least a portion of the sigmoid colon.

There is anatomic and experimental evidence suggesting:—

That sacculation of the colon is predominantly a postnatal rather than a prenatal development, but that its beginnings may be demonstrated in prenatal life, these beginnings showing individual and regional variations;

That it is due to the more vigorous muscular contractions of the walls necessitated by the colon changing from a closed reservoir to one that is called upon to empty itself;

That it is determined (a) by contraction of the longitudinal muscle bands, which tend to shorten the tube along the lines of these bands; causing the softer and more flaccid portions of the walls to become redundant between the bands; and (b) by the development of transverse depressions of these walls, which divide the colon into pouches or saccules;

And that the initial determining influence towards forming these transverse depressions, is a localized increased centripetal tendency of the intestinal wall due to the transverse course of the larger vessels and nerves upon the wall, and especially to the positive centrifugal pressure of the arterial current; this intestinal centripetal tendency and positive centrifugal arterial pressure finding counter-pressure or counter- resistance through the increased resistance of the contracting longitudinal muscle bands.

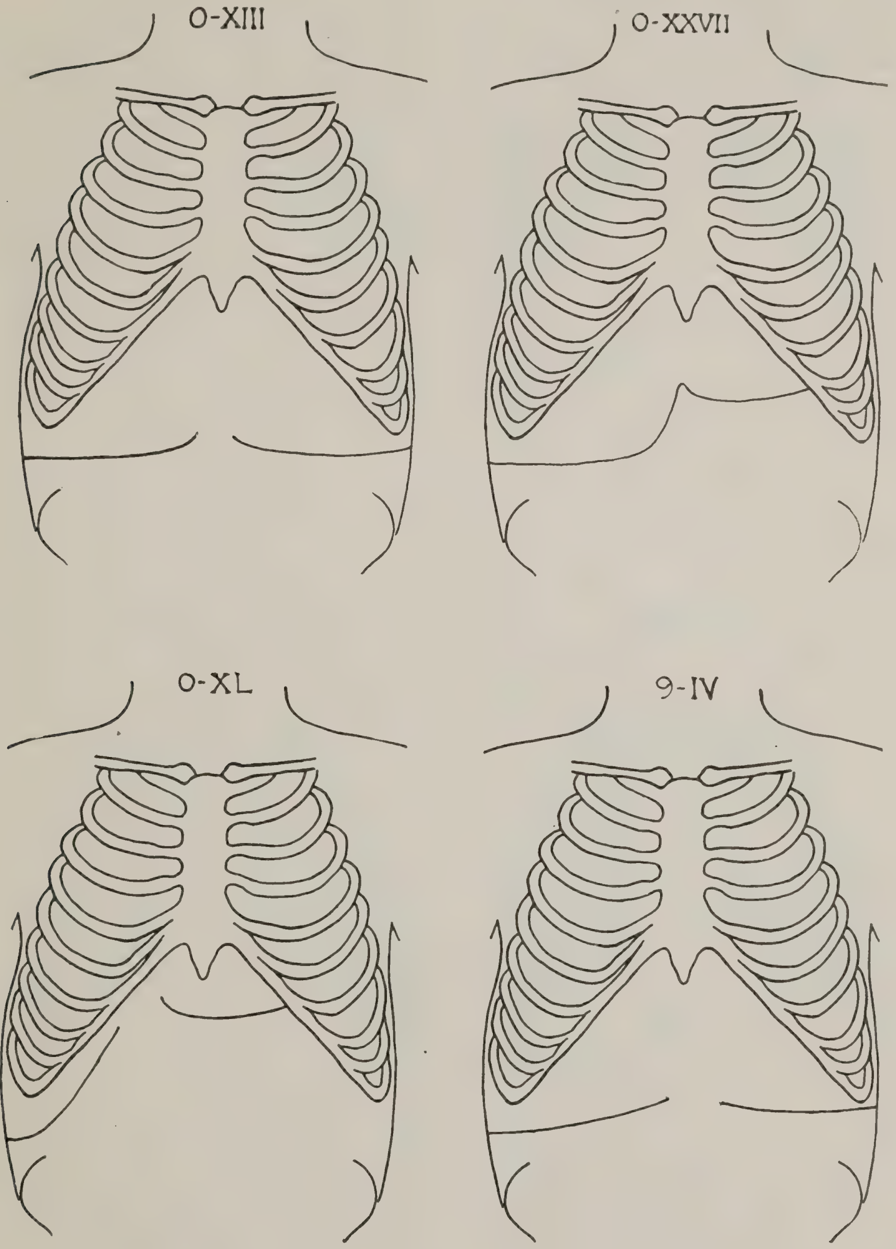
18. A pelvic-sigmoid meso is always found throughout prenatal life but there is considerable individual and regional variation in the depth of this meso, even at term.

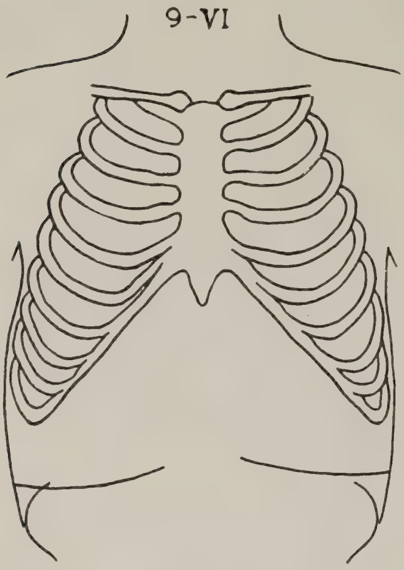
Adhesion of the iliac-sigmoid meso, and differentiation of it from the descending meso and from the pelvic-sigmoid meso, while progressing all through prenatal life may occasionally be still incomplete at term.

19. Pathologic variations, or possibilities, are noted in the direction of:—Distention (dilatation?); contraction (localized and diffused); fixation of loops by pathologic adhesions; and kinking and beginning torsion.

Plate I—Diagrams of the Location of the Lower Borders of the Right and Left Lobes (and of the Median Fissure in some cases) of the Liver at term.

(*a*) Summary of 18 cases at term—*R* = right lobe—*a*, neighborhood level apex 12th rib; *b*, midway between apex of 12th rib and crest of the ilium; *c*, crest of the ilium. *L* = left lobe—*a*, under junction 7th rib with its cartilage; *b*, under 8th; *c*, 9th; *d*, 10th; *e*, neighborhood of level of apex of 12th rib; *f*, 10 mm. above crest of left ilium. *M* = median fissure—*a*, one-fourth of the distance downward from the gladiolus to the umbilicus; *b*, one-third; *c*, one-half; *d*, two-thirds.

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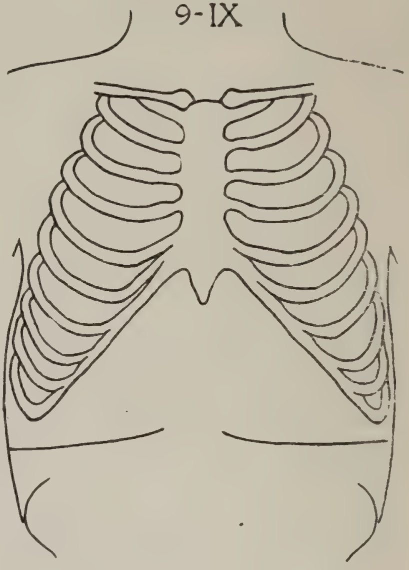
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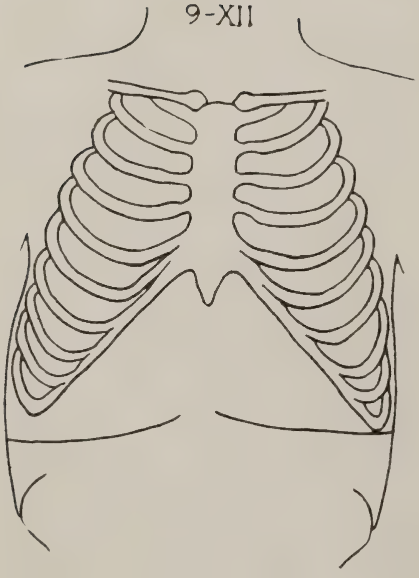
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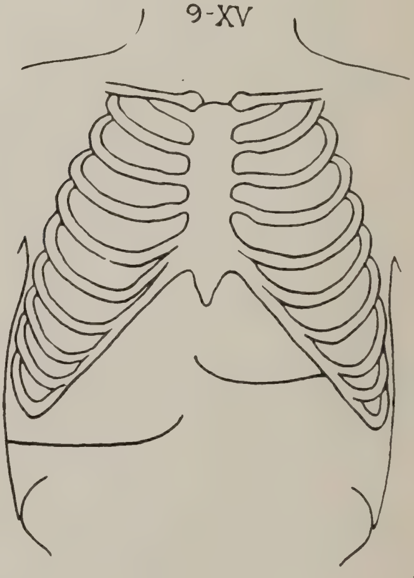
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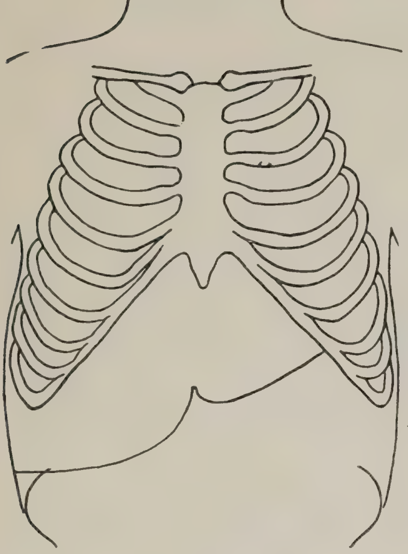

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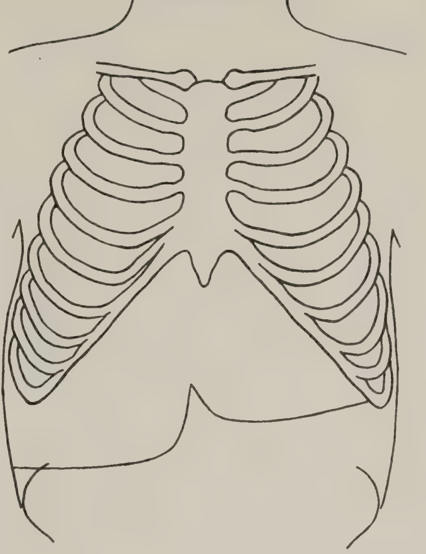

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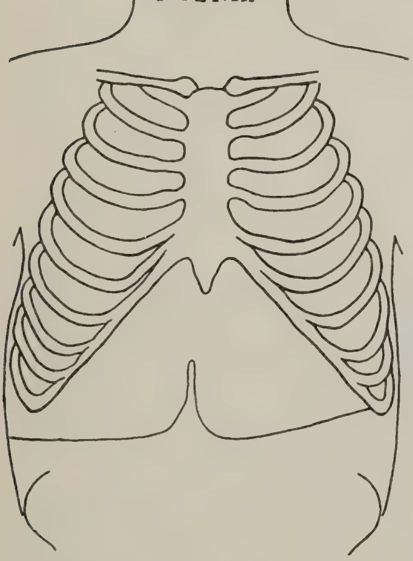

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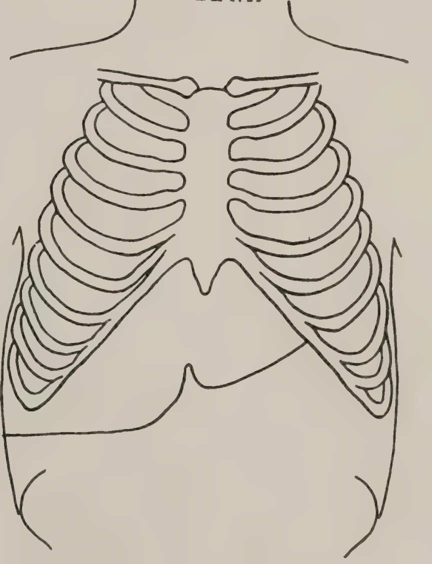

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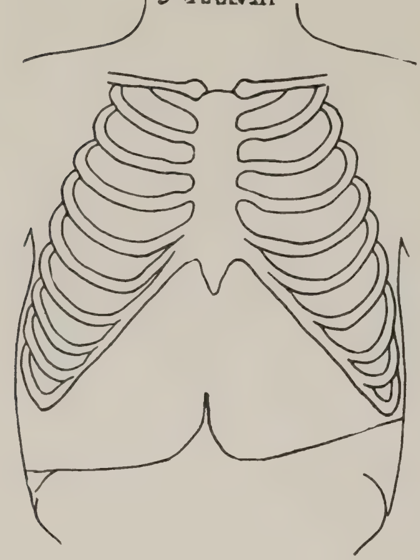

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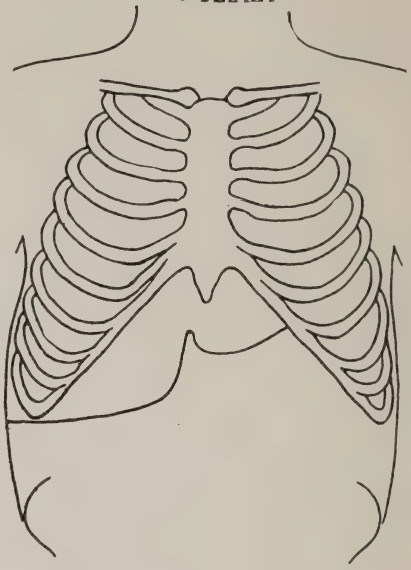

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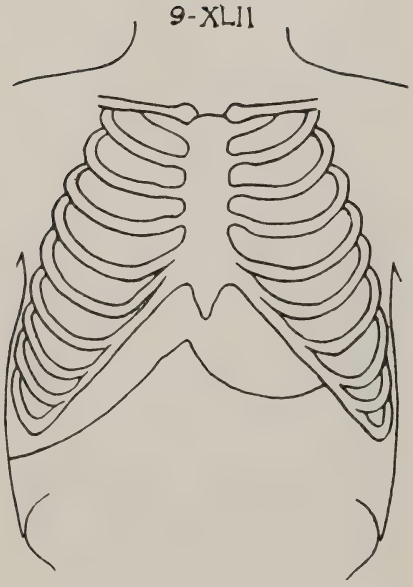

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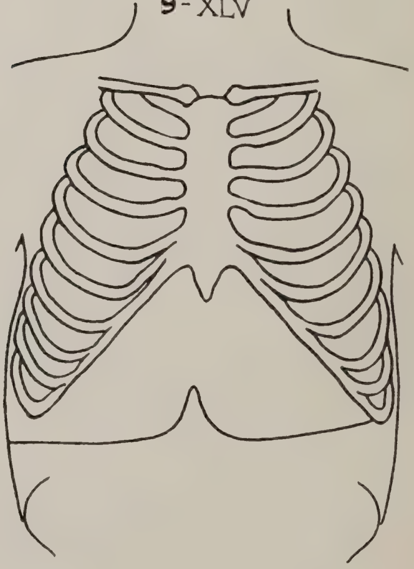
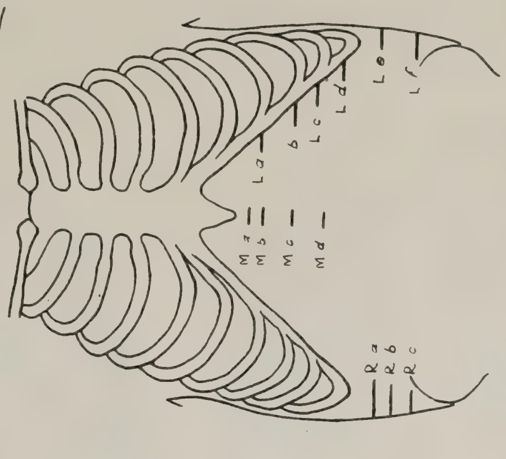


(a)

SUMMARY OF AT TERM CASES



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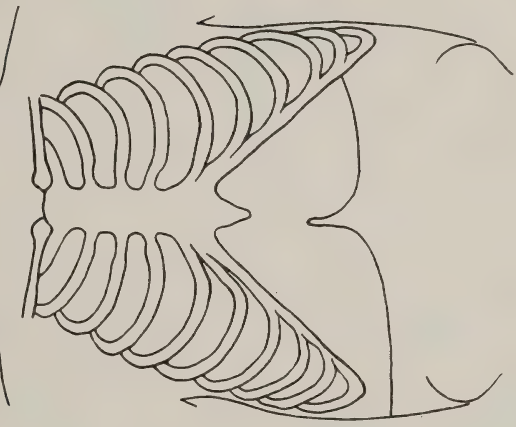

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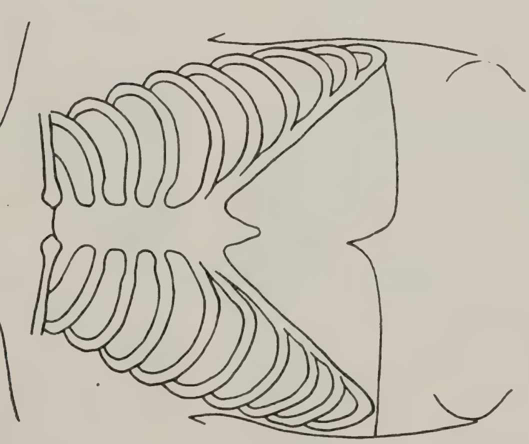
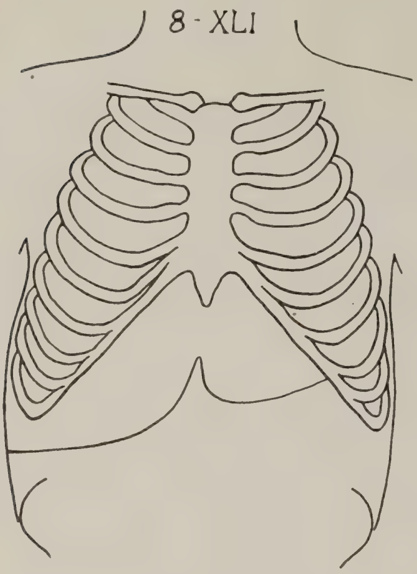
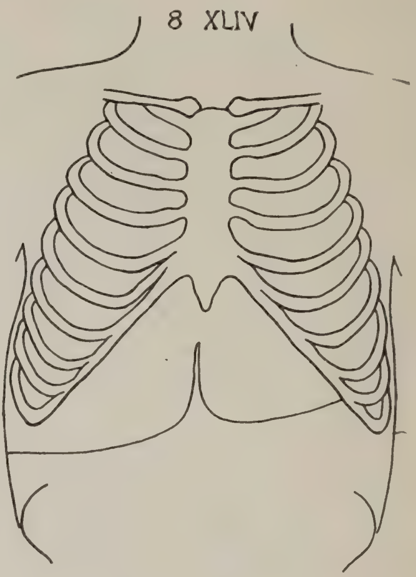
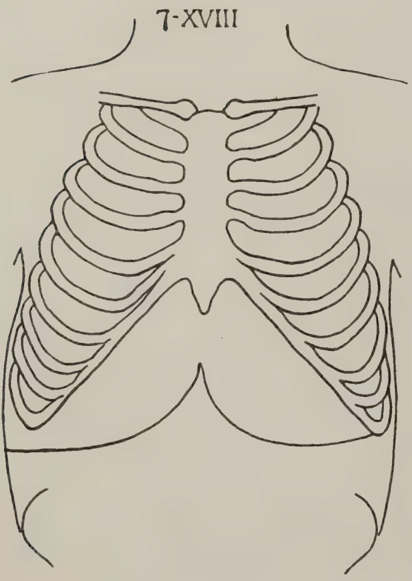


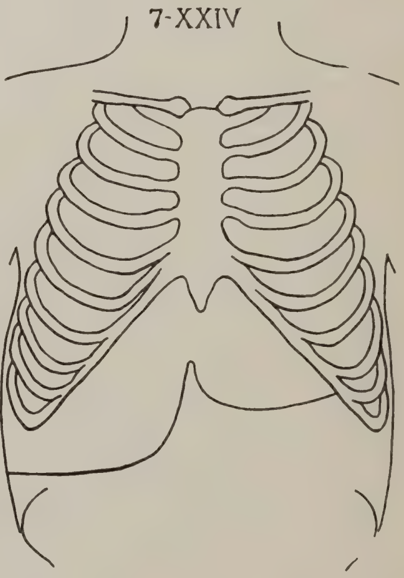
Plate II—Diagrams of the Location of the Lower Borders of the Right and Left Lobes and of the Median Fissure of the Liver in fetal cases.

(*a*) Summary of 13 fetal cases between the 4th and 8th months—*R* = right lobe—*a*, *b*, *c*, as in Plate I. *L* = left lobe—*b*, *c*, *d*, *e*, *f*, as in Plate I. *M* = median fissure—*c*, *d*, as in Plate I; *e*, just above the umbilicus.









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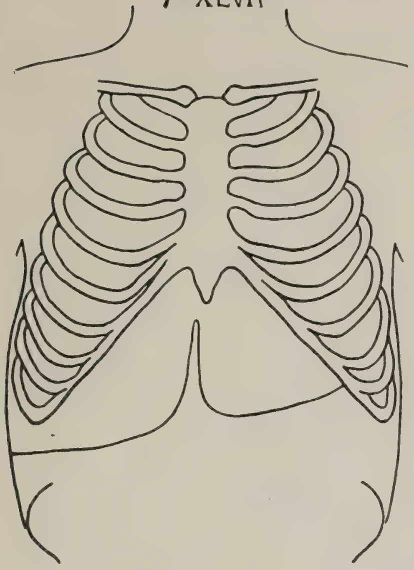

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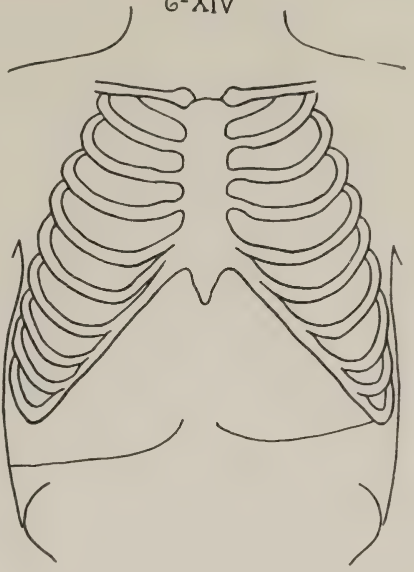

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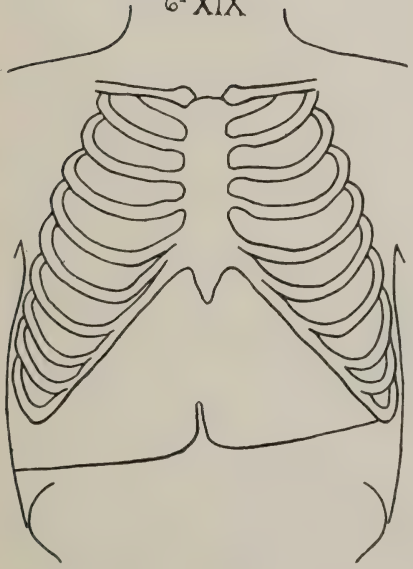

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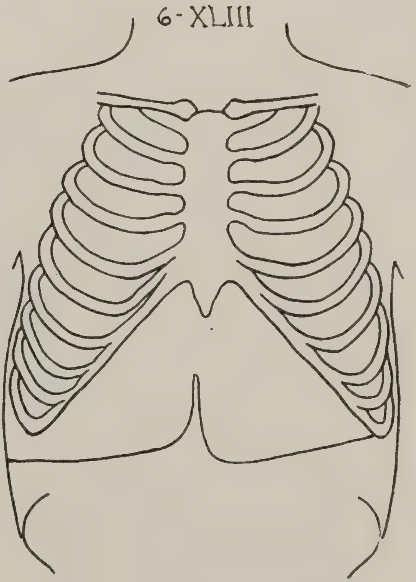

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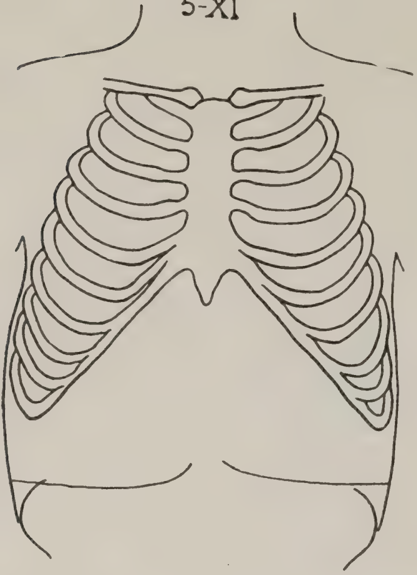

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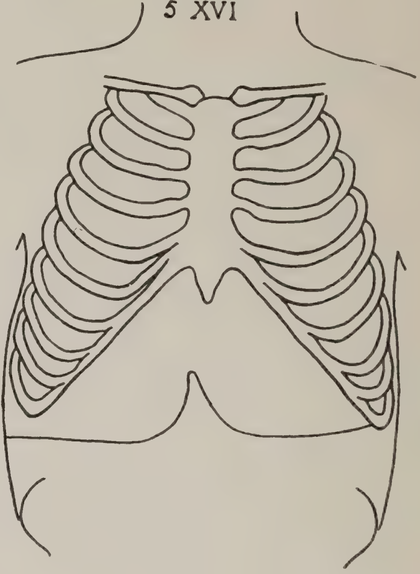

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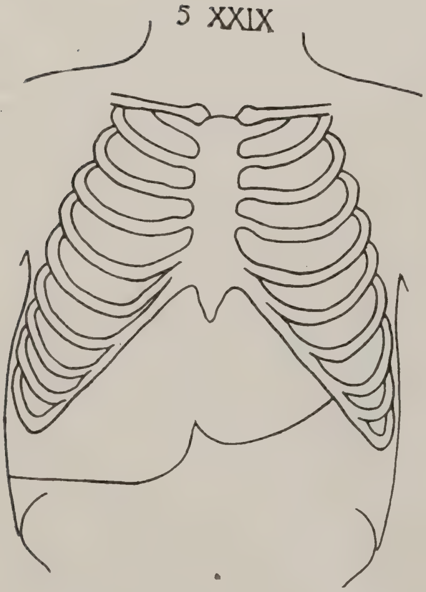

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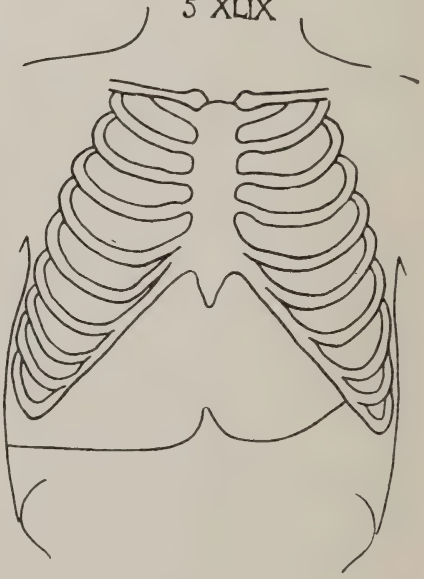

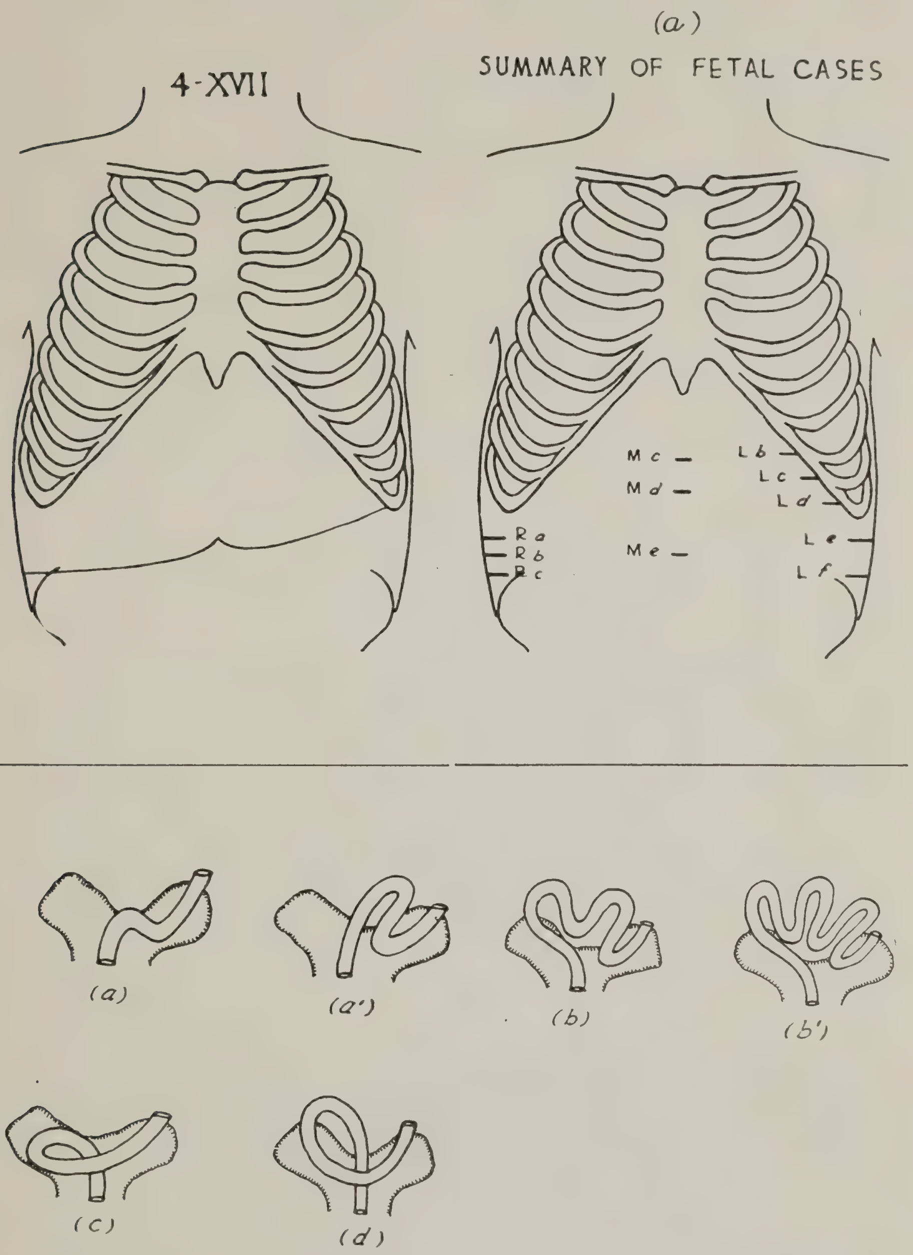

Fig. 1—Diagrammatic Representation of the Four Lines of Sigmoid Colon Location, found in Prenatal Life—(*a*) (*a′*) Left iliac fossa, hypogastrium (behind the bladder), and ascending more or less in the left pelvic or suprapelvic abdomen; (*b*) (*b′*) Left iliac fossa, hypogastrium, and ascending in the left, and thence to the right abdomen; (*c*) Left iliac fossa, hypogastrium, and more or less in the right lower quadrant, without ascending in the abdomen; (*d*) Left iliac fossa, hypogastrium, and ascends into the right suprapelvic abdomen, impinging more or less on the right iliac fossa.

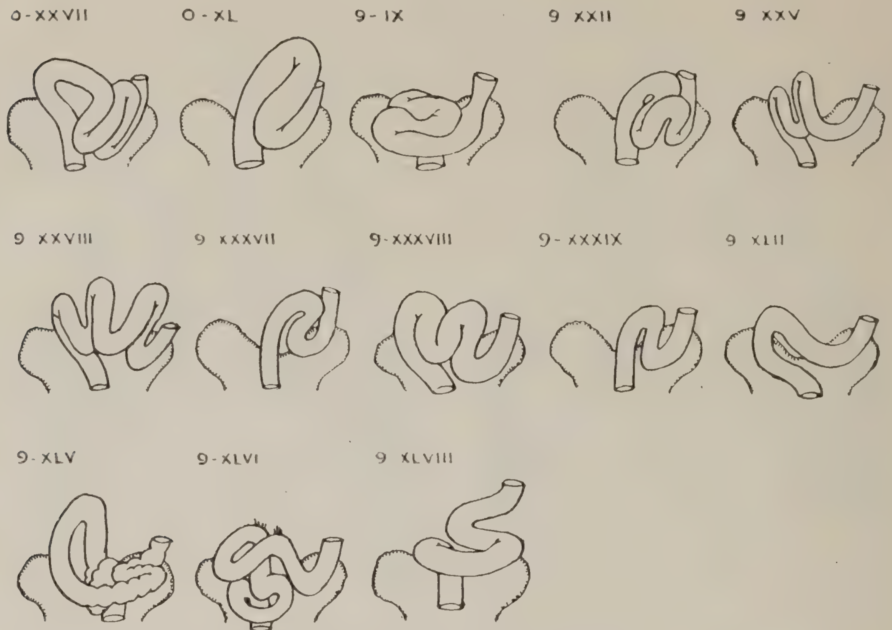

Plate III—Diagrams of the Sigmoid Colon, as found in 13 cases at term.

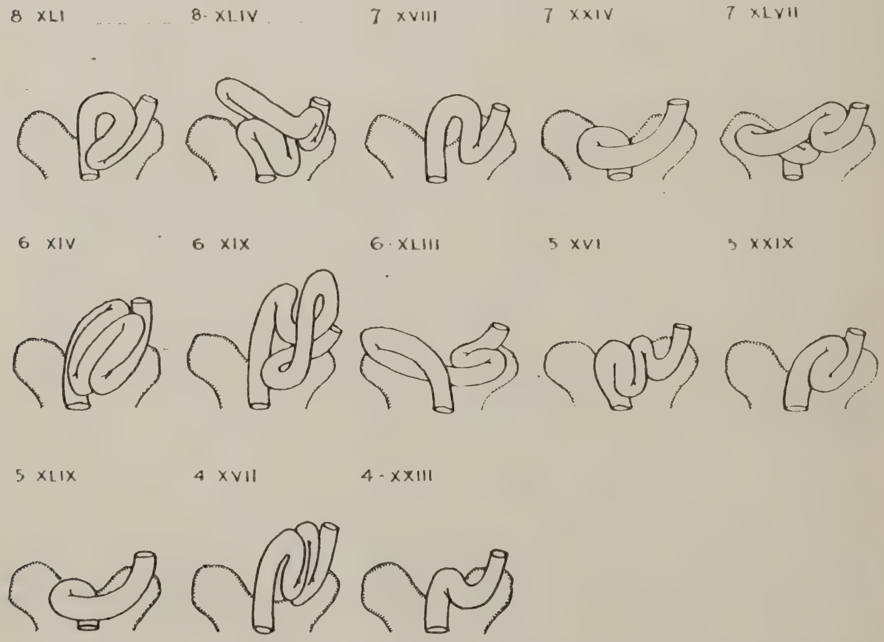

Plate IV—Diagrams of the Sigmoid Colon, as found in 13 fetal cases between the 4th and 8th months.

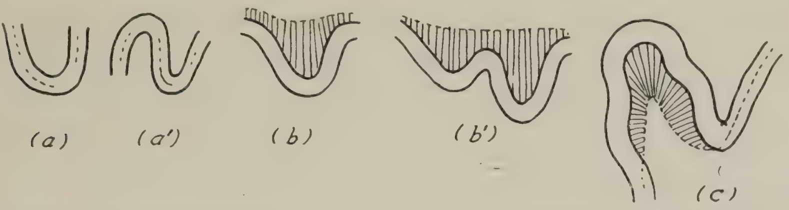

Fig. 2—Diagrammatic Representation of Some Forms of Developmental Fixation of Intestinal Loops—(*a*) (*a'*) The intestine is not redundant and the parietal adhesion of the meso is regular and complete. This line of adhesion is curved so as to describe a loop; (*b*) The intestine is redundant and the adhesion of the meso is irregular, forming a fixed loop; (*b'*) The intestine is redundant and the adhesion of the meso is irregular, forming a fixed loop which is subdivided into two secondary fixed loops; (*c*) The intestine is redundant and the adhesion of the meso is irregular, forming one large basal fixed loop with suggestions of subdivision which may at times predispose towards the formation of secondary loops without definitely fixed bases.

TREATMENT OF CARDIAC FAILURE DURING PREGNANCY*

BY

HAROLD E. B. PARDEE, M.D.
Consultant in Cardiac Diseases.

I DESIRE at the outset to make a distinction between the importance of cardiac disease during pregnancy and of cardiac failure during pregnancy and to explain exactly what I wish to have understood by the term cardiac failure. Evident cardiac disease with loud murmurs may be present without any sign of cardiac failure. Mitral regurgitation, or mitral stenosis, or aortic regurgitation or combinations of these may exist and yet the patient may not be conscious even after ordinary exercise of any abnormality of the heart. Such a person has cardiac disease but not cardiac failure. On the other hand even a normal person will suffer from breathlessness or palpitation after exercise, if only the exercise is sufficiently strenuous or prolonged. This breathlessness is due to a cardiac failure which might be called physiologic. Pathologic failure is present when these symptoms make their appearance after exertions which the person was formerly able to undertake without causing them, and it is this degree of cardiac failure which concerns us at present.

One will realize readily that there will be many grades of cardiac failure. The mildest sort is shown by the patient who complains of an unusual breathlessness after climbing two or more flights of stairs, and the most severe sort by a patient in whom even the exertion of turning over in bed causes palpitation and shortness of breath.

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*Read before the section on Obstetrics and Gynecology of the New York Academy of Medicine, January 24, 1922.

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When considering cardiac failure during pregnancy we must bear in mind that a normal woman who becomes pregnant will find her ability to exercise without causing dyspnea and palpitation is less than it was in her nonpregnant state. Such a degree of cardiac failure during pregnancy is physiologic and not abnormal. There are also many women otherwise normal, who develop more or less edema of the legs during pregnancy because of pressure upon the veins by the pregnant uterus, so that if a patient with heart disease shows a slight limitation of her ability to exercise during pregnancy, and perhaps also a certain amount of edema of the legs we must not feel that these signs are a cause of alarm.

There is a long standing tradition in medicine, supported by even so high an authority as Sir James Mackenzie,[1] that mitral stenosis is a most serious lesion for the pregnant woman. This has not been my experience at all, for though some patients with mitral stenosis have been the cause of much trouble and anxiety, yet others have gone through with no untoward event, their hearts behaving quite as if there were no cardiac disease at all. I believe that the reason for this impression of the seriousness of mitral stenosis is, that there are twice as many patients with mitral stenosis as with aortic disease. It would be reasonable then to have twice as much trouble from the former patients as from the latter if the lesions were of equal gravity. As a matter of fact 4 of the 8 uncomplicated aortic cases which I have observed have had serious heart failure, while only 4 of 17 uncomplicated mitral stenosis cases had serious heart failure. Certainly from this experience mitral stenosis does not seem to be as dangerous as aortic regurgitation.

When a pregnant woman presents herself with evident signs of cardiac disease, we are less concerned with the nature of the disease than with the finding of symptoms or signs of cardiac failure, and with a determination of the severity of these symptoms or signs. This question of the fitness for pregnancy is a difficult one of itself and is being dealt with elsewhere[2]. The subject I wish to emphasize at present is the treatment of those patients who show signs or symptoms of cardiac failure.

Two factors are of prime importance in the treatment of such a woman and their importance is almost equal though in a quite different way. One is the degree or the relative severity of the patient's cardiac failure, while the other is whether we first see the patient before or after labor has set in.

SEVERE FAILURE DURING LABOR

The most dangerous situation is that of severe cardiac failure which has come on during labor. The patient may have had much shortness of breath on exertion during her pregnancy or she may have had but little. The important thing is that during labor it has been noticed and has become steadily more severe. The pulse is rapid, 120 or more per minute, and there may be a marked sense of suffocation with cyanosis and the coughing up of a pinkish frothy mucus. The patient is unable to lie down because of the dyspnea. The lungs show diffuse rales and the veins of the neck are much distended. This is the extreme picture of severe decompensation with edema of the lungs and shows that the heart has been severely overtaxed by the strain of labor. It is an acute decompensation or at least an acute exacerbation of one of lesser grade, and since the strain of labor was the provocation, the indication for treatment is an imperative one to do away with this strain and at the same time to treat the acute cardiac failure.

A hypodermic of morphine sulphate 1/4 grain along with atropine sulphate 1/50 grain helps these patients greatly, so does phlebotomy, if the neck veins are markedly distended, withdrawing enough blood to relieve the distention. From 6 to 8 or 10 ounces will usually suffice. If the patient has not had digitalis previously she should receive digitoxin intravenously in a single dose of 1/50 of a grain, which should not be repeated as it is half of the average therapeutic dose. If digitalis has been given previously we cannot give an intravenous dose without knowing exactly how much the patient has received.

If the morphine stops the labor temporarily so much the better,—for the patient and the patient's heart will have a temporary rest. Operative interference at such a juncture is a very bad risk, but if labor continues or starts up again and there is no indication that the treatment has helped the heart to regain control of the circulation, then the uterus should be emptied as quickly and with as little manipulation of the mother as possible. I feel that abdominal section is the best method if the head is high and a forceps extraction if it is in a low position. Do not move the patient from her home to a hospital without bearing in mind that the strain of the removal on a heart in this precarious state of compensation may be the deciding factor against her recovery. I would object to version because of the shock which accompanies intrauterine manipulations, and to vaginal section because it is a slower process and accompanied by more trauma to the patient than is the abdominal operation. It seems to me necessary to consider the effect of operative manipulations on the mother.

I believe that ether preceded by a small amount of chloroform is a better anesthetic than gas and oxygen because of the strain on the heart. I have seen an attack of acute decompensation brought on by the giving of gas to lance an infected finger, the patient being in the sixth month at the time and later going through a labor which was accelerated by version and rapid extraction of the child, without showing signs of more than slight embarrassment of the heart.

Severe Failure During Pregnancy

Patients may have a severe acute decompensation during pregnancy at any time after the second or third month, because of excessive physical activity, either prolonged or of an acute nature. I have known sexual intercourse to cause this in several cases. Treatment of these patients is in no respect different from that described above except that if other measures fail to diminish the cyanosis, inhalations of oxygen are indicated. The reduction of cyanosis must be of great benefit to the heart muscle, for this likewise suffers from lack of oxygen.[3] The heart can often be observed to slow down when the cyanosis is diminished. Oxygen must be given from a closed inhaler or by nasal tube for at least 10- or 15-minute periods or more to be sure of producing its full effect. The pulmonary edema makes it difficult to get the gas into contact with the pulmonary capillaries. The objection to giving it to a case in labor is that it may, by preventing sleep, keep the morphine from checking the labor and giving the heart a much needed rest.

Operative interference of any sort is extremely dangerous when the heart is severely decompensated even when the patient is not in labor and therefore should not be undertaken unless there are indications that the compensation will fail still further, and that the patient is not reacting to treatment. If it is considered imperative for either of these reasons, then I feel that abdominal section is the operation of choice for the reasons which have been already mentioned.

When the patient has regained her compensation—and it is our experience that they always have done so from the first attack, though not always from a later one—then it is advisable to consider very carefully whether the pregnancy should be allowed to proceed to term. The question to be faced is how much chance we shall take with the mother's life in order that this child shall be borne. How important is it that she should have this child?

In some cases pregnancy will proceed successfully and uneventfully even after a severe decompensation, while in other cases it does not. It is beyond our present knowledge to determine with exactness whether a given woman will or will not have trouble during labor. Difficult labor will be more likely in a primipara with a large child however, and so cardiac failure will be more likely under these circumstances than if a multipara should have a precipitate delivery of a seven or eight months' child.

If we are willing to take a certain chance, I believe that even a woman who has had an acute decompensation during pregnancy can be safely carried along with proper medical supervision as will be detailed later. If she should have a second acute attack, the uterus should be emptied as soon as compensation is sufficiently regained, but with proper care a second acute attack will but rarely occur. Such a patient should never be allowed to go longer than the fortieth week of gestation, for a large child will be an added strain at delivery. To be safe on this point, if we think that the pelvis is small or if the woman is a primipara, it might be better to induce labor before this time. Opinions differ as to whether induced labor at the eighth month is easier than at term. The features of the individual case will often be decisive on this point.

When labor starts we must watch very carefully for the first indication that the heart is not standing the strain, and be ready to perform an abdominal section, unless the head should be in a position for a quick forceps delivery. Here again the shock of a version seems to contraindicate this procedure, and a high forceps operation or a vaginal section is too slow a method for the emergency of a failing heart. We must do away with the strain of the labor, with as little trauma to the patient as possible.

The indications of heart failure during labor which should point to prompt interference are a quickening of the pulse to over 95 per minute, or of the respiration to over 25 per minute, or the appearance of any sensation of distress such as dyspnea, or cough, or precordial discomfort. The more of these signs or symptoms that appear the more urgent the state of the patient. We should never wait for marked dyspnea and a pulse of 120 or more, for the strain of operation at that time will almost surely be too much for the already overtaxed heart. Watch the patient from the beginning of labor, and if the pulse or respiration is increasing I believe it is safer for both mother and child to operate at once, than to wait in the hope that delivery will take place before the strain has resulted fatally for the mother. We should operate when the decompensation is slight or moderate, in order to avoid having to operate when it is severe.

Lesser Grades of Failure

In regard to patients with lesser grades of heart failure it is difficult to make general statements which will apply equally to every case. There is, besides the variation in the degree of cardiac insufficiency from one patient to another, a variation in the same patient from time to time. Some patients grow worse during the course of their pregnancy, while others improve surprisingly in their cardiac power. Moreover there is the greatest variety in the activities which different women pursue during pregnancy, and the more active woman is naturally more liable to overstrain her heart.

I would never advise abortion or premature delivery before the eighth month unless it had first been demonstrated that with proper treatment by rest and digitalis, the signs and symptoms of cardiac failure were persistently increasing.

At the outset of treatment the patient should be kept in bed. This applies not only to the severe cases, but also to the mild cases of decompensation, and they should be kept there as long as any noteworthy increase in the pulse or respiration results from such efforts as sitting up or turning over in bed. They will usually be more comfortable in bed with a backrest on account of the dyspnea. When the patient is able to move about freely in bed without any discomfort from her heart she should be allowed to try the effect of sitting in a chair. If this causes no fatigue or dyspnea or palpitation, she may, after being in the chair a few hours each day for from seven to ten days, be allowed to walk a few steps. If this does not cause discomfort she may gradually be up more and more, always keeping short of any exertion which is followed by palpitation or a sense of shortness of breath or any other discomfort. As long as she keeps this principle in mind she will not harm her heart by overstrain.

When the patient is allowed to be up the pulse rate should be taken twice daily and she should be carefully questioned from time to time as to what she is doing and what abnormal sensations, if any, may arise. If she is of the type who persist in doing more than they should, then she must be kept in her room or in the house or even in bed if necessary to prevent this overdoing. Similar patients when not pregnant feel better and do better when they are allowed a certain degree of freedom and activity than when kept closely confined, and though my experience with such patients during pregnancy is more limited than with uncomplicated cardiac failure of the same degree, yet I have seen nothing to make me feel that the treatment should be any different in principle merely because of the abdominal tumor and the increased vascularity of the uterus, though it is plain enough that the same degree of activity is more strain during pregnancy than before.

If a patient who is allowed up does not continue her improvement, or if the pulse tends to remain above 85 per minute, then it is likely that a further period of two or three weeks' rest in bed or sitting about her room will be helpful in improving her compensation. Her heart was evidently having too frequent demands upon it and rest is needed to allow it to recover from its state of chronic fatigue. Some patients, while keeping short of a severe overstrain, will continually throughout the day, push the demands upon their heart so near to its limit that it can just hold its own. A little extra rest will enable it to gain an ability which may be more than adequate for the former demands.

The diet is of but secondary importance in these patients unless the cardiac failure is severe, and then should be restricted as to fluids and salt according to the well-recognized principles for the treatment of such patients.

At the outset of treatment digitalis should be used. If a preliminary intravenous dose of digitoxin has been given because of the urgency of the symptoms, it should be followed in two or three hours by the oral administration of 30 minims of the tincture well diluted with water so that the nauseous taste will not cause vomiting as it often does with the congested stomach present with severe failure. The less severe cases who do not need the intravenous dose may be started at once with the tincture or the powdered leaf, the dosage depending upon the urgency for obtaining an effect. At the outset at least as much as 60 minims of the tincture should be given per day, or 6 grains of the powdered leaf. Digitalis is best given at intervals of at least twelve hours, following the initial doses which may be given at smaller intervals, so that 30 minims or 3 grains night and morning would be a proper dose with which to continue the medication, or even for starting it if there were no urgency for obtaining digitalis effects. With this dosage we must watch the patient carefully for the early signs of full digitalization, for they will appear at some time between the third and the seventh or eighth day. Stop the drug promptly at the first sign of its activity and resume after a two or three day intermission with 10 minims of the tincture or 1 grain of the leaf night and morning. The further course of digitalis treatment must be carefully individualized for each patient, so that enough is given to maintain the effect and yet not so much that severe toxic symptoms will make their appearance.

The question of how long digitalis should be continued is also one that will have to be determined for each case. It should be kept up as long as the patient continues to improve and for a week or ten days thereafter. It should be resumed if there is any sign of a relapse on stopping the drug, continued for another month and then stopped again to see whether it has not become superfluous. Possibly it might be well during the month preceding the expected labor, to thoroughly digitalize all patients who have shown any signs of failure during pregnancy, considering it as a sort of prophylactic against a serious break in compensation at that time.

Summary

The important feature of a patient with heart disease during pregnancy is the degree of cardiac failure. If this is slight the disease is of little importance.

Even with a moderate degree of failure it will be possible for the child to be born if the mother is allowed to take a risk which is not so great as sometimes stated.

The first attack of severe decompensation can usually be recovered from with proper treatment, unless the attack should occur during labor.

With proper observation and prompt operation severe decompensation should not occur during labor.

Abdominal section is the operation of choice in the emergency, provided a low forceps cannot be done. Ether anesthesia started by chloroform is a better anesthetic for these patients than gas-oxygen.

Oxygen inhalations from a mask are helpful to clear up a persistent cyanosis.

Without severe cardiac failure or after recovery from it, most patients can be carried through to term or to an induced labor during the eighth month.

During labor, watch for a pulse over 95 or respiration over 25 per minute, precordial discomfort, dyspnea, cough, and do not let these little signs become big before putting an end to the labor.

In treating lesser grades of failure during pregnancy, the patient must rest enough to spare the heart from overstrain, but this may not necessitate rest in bed for more than a short time.

Digitalis should be given in doses sufficient to insure an effect.

With this treatment I feel sure it will be possible to diminish the present mortality of about 25 per cent for severe cases and 10 per cent for all cases to a figure which is less disquieting.

References

1. Heart Disease and Pregnancy, Oxford University Press, London, 1921.
2. *Jour. Am. Med. Assn.*, 1922, xxviii, 1188.
3. Barach, A. L., and Wordwell, M. N., *Arch. Int. Med.*, 1921, xxviii, 367.

AN ANALYSIS OF CASES OF BACTERIEMIA OCCURRING AT THE LYING-IN HOSPITAL 1920-1922

BY

MEYER ROSENSOHN, M.D.
Attending Surgeon

During the past two years there were noted at the Lying-In Hospital 22 cases of real bacteriemia in connection with pregnancy. Of these 11 cases occurred in 1920 out of a total number of 4546 cases cared for by the hospital on its Indoor and Outdoor Services and 11 in 1921 out of a total of 5056 similar cases, a percentage of 0.24 for the first and 0.21 for the other year. Of these 22 cases, 18 were under the care of the hospital staff before labor as well as in the intra- and postpartum periods, the other four having had outside manipulations and being probably already infected when admitted to the hospital. In the latter group were two cases in which high forceps operations had been attempted and failed, and where on admission to the institution, a craniotomy was performed in one and an extraperitoneal cesarean section in the other; the third case was a forceps delivery where on the third day postpartum, the patient was referred to the hospital and died within five days of admission: the fourth was a patient delivered under the care of a midwife two days before admission, she died within nine days. Of the 18 cases thus left, one patient was admitted with a lobar pneumonia and was delivered spontaneously of a premature fetus: in her a pneumococcus type IV was recovered in the blood culture: she died of pneumonia within five days of admission. Three other patients were admitted with high temperature, urinary and blood evidence in whom B. coli was recovered from the blood stream. Eliminating for the time these four cases, we have left 14 cases of bacteriemia which developed during the hospital stay, a percentage of 0.14 in the total cases for the two years 1920 and 1921 cared for by the hospital.

Excluding from consideration the case of frank pneumonia with the associated pneumococcemia, there were twenty-one cases practically evenly divided between primiparae and multiparae as shown by table one, with a total mortality of 12 in 21 or 57 per cent.

TABLE I.

	Recovered	Died	Total
Primiparae..........	5	6	11
Multiparae..........	4	6	10
	—	—	—
	9	12	21

The youngest primpara was 19 years (fatal), the oldest 31 (recovered), while the youngest multipara was 21 years (para II,—recovered) and the oldest 44 (para XI) with a para X, age 42, both of whom died. For the rest there was one other para II with a mortality of 1, four para III with a mortality of 2, one para IV with recovery.

The deliveries were spontaneous in 9 cases with a mortality of 33 per cent while there were operations in 12 with a mortality of 75 per cent as shown in table II.

TABLE II.

	Recovered	Died	Total
1 Nonoperative deliveries			
Vertex..........................	5	2	7
Breech..........................	1	1	2
	—	—	—
	6	3	9
2 Operative Deliveries			
Version..........................	1	4	5
Forceps..........................		3	3
Craniotomy....................		1	1
Abdominal Cesarean............	1		1
Vaginal Cesarean...............	1		1
Extra peritoneal cesarean.........		1	1
	—	—	—
	3	9	12

As to the possible influence of perineal lacerations, a study of Table III would indicate a better prognosis where no lacerations of the birth canal had occurred.

TABLE III.

Perineal Lacerations	Recovered	Died	Total
A Non-operative deliveries			
No Lacerations	5	2	7
1° Laceration		1	1
2° Laceration	1		1
	—	—	—
	6	3	9
B Operative Cases			
No Lacerations	2	0	2
2° Laceration	1	6	7
3° Laceration	0	3	3

Of the three operative cases which recovered, two were cesareans (one abdominal and one vaginal) with no lacerations and one a version had a second degree laceration.

The type of organism producing the bacteriemia is of importance in the outcome, the greatest mortality being associated with staphylococcus aureus and albus and combined infections and the best prognosis being with B. coli and nonhemolytic streptococcus. In table IV is given in detail the type of organism. It may be well to note here, especially with reference to the staphylococcus albus infections, that all blood cultures were taken with the same technic by Dr. J. R. Losee, pathologist and were always confirmed by a second culture to eliminate the probability of a skin contamination.

TABLE IV.

	Died	Recovered	Total
Staphylococcus aureus	2		2
Staphylococcus albus	2		2
Streptococcus hemolyticus	5	3	8
Streptococcus nonhemolyticus	1	2	3
B. coli		3	3
Pneumococcus		1	1
(Combined) Streptococcus nonhemolyticus and B. coli	2		2

Of those recovered the shortest stay in the hospital was 15 days and the longest 91 days with an average of 36 days.

A point of interest from a study of these cases has been the occurrence of metastatic foci of infection and their influence on the prognosis and this is well shown in Table V, where the development of metastases would seem to indicate a better outlook.

TABLE V.

Excluding three cases of B. coli infections where the conditions seem to indicate purely kidney involvement:

	Recovered	Died	Total
Metastatic foci	5	2	7
None	1	10	11

CASE REPORTS

There were three cases of placenta previa. In two of the central type (No. 2 and 5 in Table VI), the patients were admitted because of the antepartum hemorrhage, were packed with iodoform gauze to control bleeding and to favor cervical dilatation and were delivered several days later, in both cases after repacking. In Case 2, the patient was packed March 18th, repacked March 19th and delivered March 24th. In case 5, packed December 1st, repacked December 6th and delivered December 11th. In both cases cervical dilatation had to be completed manually, version was done with subsequent manual extraction of the placenta. The question naturally arises whether the manipulation incidental to the packing and repacking as well as the predisposing factor of the low placental implantation did not induce the fatal septicemia; and whether in such cases it would not be better to manipulate as little as possible within as short time as permissible; in other words to avoid a second packing and to deliver immediately after the first packing has been removed.

No. 10: The third case of placenta previa was of the marginal type in whom a bag was introduced on June 21st and in whom the cervix was manually dilated on June 22nd.

CASE 20: Was a case where high forceps had been attempted on the outside in a patient with a flat pelvis. An extraperitoneal cesarean section was done.

CASE 16: Was a patient admitted with double mitral disease, about five months' pregnant, B. coli in the blood and auricular fibrillation. When admitted she had a temperature of 103°; this with her heart lesion and her appearance clinically as well as the presence of a spleen suggested the diagnosis of infectious endocarditis. B. coli was recovered from the blood stream and subsequently from a catheterized specimen of urine. A vaginal cesarean was done by Dr. A. B. Davis and after a stay of 71 days she was discharged well, cured of the bacteriemia with improvement of the heart lesion. It is interesting too, to note that this patient for her fibrillation was given quinidin with relief of this condition during the period of her observation.

CASE 13: This was a patient in whom an abscess of the arm developed and a metastatic choriditis necessitating the removal of the eye. In her the hemolytic streptococcus was found in the blood stream. She recovered.

CASE 7: This was a patient delivered spontaneously in the care of the Outdoor Division with a moderately severe postpartum hemorrhage of about 800 cc. in the third stage. She had no fever and no complications during the puerperium and was discharged on the ninth day. She was admitted on the twelfth day with fever and evidence of a pelvic exudate. A blood culture on admission showed pneumococcus type I. She was given three injections of pneumococcus type I serum on three successive days with improvement clinically. The exudate took some time to absorb but was not aspirated.

The group of three cases in whom B. coli was recovered is of interest because of the fact that in all, evidence of a pyelitis, with urinary symptoms and fever existed, and because of the complete recovery.

A brief word as to treatment in these extremely serious cases of bacteriemia may not be amiss. Except in the pneumococcus type I infection where we had and used a definite serum we have no specific treatment. In the B. coli infections where possible the assistance of the genitourinary surgeon for diagnosis and treatment has been utilized. Where complications of any kind arose, these were treated on surgical and medical principles but for the uncomplicated case or for the underlying bacteriemia no treatment other than supportive and symptomatic is of value. We, at the hospital believe firmly in the advantage of open-air treatment from this point of view and all such cases are sent to the solarium.

SUMMARY

The analysis of the cases of bacteriemia occurring in the last two years at the Lying-In Hospital show

1. An incidence of 14 cases in a total of 9602 or 0.14 per cent, which developed in the hospital after admission.
2. Of 22 cases reported, excluding one frank pneumonia complicating pregnancy with a pneumococcus Type IV in the blood, the 21 cases were almost evenly divided between primiparae and multiparae with a total mortality of 57 per cent.
3. There was a mortality of 75 per cent in the operative cases as compared with 33 per cent in the spontaneously delivered cases.
4. The occurrence of perineal lacerations increased the mortality.
5. The greatest mortality occurred in cases where staphylococcus aureus or albus or several organisms were recovered from the blood stream: the best prognosis seemed to go with B. coli and nonhemolytic streptococcus.
6. In cases where there were metastatic foci of infection, the mortality was less than in cases where no such lesions existed.

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Bulletin of the Lying-in Hospital
of the City of New York

Vol. XII AUGUST, 1923 No. 4

PROBLEMS OF OBSTETRICAL PRACTICE*

BY

WALTER W. CHIPMAN, M. D., F. A. C. S.
Professor of Obstetrics and Gynecology
McGill University, Montreal, Canada

PARTURITION is a physiological process, identical in the countess and in the cow, at least, until recently, it has been so regarded. Physiological the process is, yet as regards the countess, — and every mother is a countess, — this natural process still remains a hazardous occupation. The price of motherhood is still "cruel high".

If it is important to be in the world at all, the matter of this entrance, and the price of this admission, are surely of first consideration. And yet, oddly enough, as compared with the sister subjects of medicine and surgery, obstetrics has rather been, not a first, but a last consideration, and it still runs against these a bad third in the race. You will remember that clinical instruction in obstetrics was inaugurated in this country by Dr. James P. White, of Buffalo, as late as the year 1850; so that, in all truth it may be said that adequate training in this important subject indeed got away to a bad start.

Dr. Thomas Watts Eden, of London, in a recent address, on "The Maternal Mortality of Child-Bearing," informs us that the average mortality rate in Great Britain is still about five in every thousand births; and that during the past ten years, this mortality rate has remained about stationary, showing little or no improvement. The worst of this showing is that only half of these maternal deaths were due to hemorrhage and the accidents of childbirth: whereas a second half was due entirely to sepsis. In the Registration Area of the United States, which represents but two-

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*Read by invitation at a meeting of the Alumni Society, March 2, 1923.

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thirds of the total area of the country, 11,500 women die annually in childbed, a showing but little better than that in the United Kingdom, when even in this newer and wider country, a full half of these deaths are again due to sepsis.

At first sight, five maternal deaths for every thousand births may not seem a too-unreasonable price to pay; but when we compare this number with the total death rate of some fifteen per thousand of the population, this maternal mortality is at once recognized as, beyond all question, criminal and exorbitant. Put in this way, the case stands strongly against us, inasmuch as these mothers pay a full third of the total price, — the mother in the prime of life, the most valuable citizen in the community, — dying often from a preventable disease.

The causes of this high maternal death rate are not "still to seek". Dr. George M. Boyd, of Philadelphia, recently found that nine tenths of all mothers in America receive no prenatal care; that 40 per cent of the women of the United States are attended by midwives or unqualified physicians; that the general mortality in childbirth is second only to that from tuberculosis, in women of this age, and that nearly half of these deaths are due to sepsis. In Great Britain there is the same story, for, despite the pioneer work of the late J. W. Ballantyne of Edinburgh, antenatal care is still in its infancy, and more than half the mothers are still delivered by the midwife. Now, these are the facts, and assuredly, they carry their own condemnation, declaring in no uncertain terms our national indifference and neglect. For in this way, the expectant mother is left more or less to shift for herself, at the very time when her need is the greatest. So left to herself in this great maternal service, one mother in every two hundred comes to make the supreme sacrifice.

As I have said, obstetrics got away to a slow start, and there is still far too much truth in the opprobrium from the general surgeon, that it is safer for the woman in this country to have her abdomen opened for any chronic condition than it is to bear a child. And yet, in all conscience and common sense, obstetrics should run first in this race. Medical science and medical skill should be concentrated here, at the gateway of life, and concern themselves first with what may be called this world immigration. It *is* of the first importance to be in the world, and well in the world.

It is always essential for us to remember that in 90 per cent of all cases, the labor is spontaneous, and that a vast proportion of these mothers must always be delivered in their own homes. They cannot come to us in our hospitals and training schools, but, on the other hand, we of these schools must go to them. We must send to them the well trained doctor and the nurse and provide in the home a well adapted and an efficient technique. So, in a practical, life saving way, we must go to them. This is but another way of saying that we must raise the general standard of our training, must furnish men more thoroughly equipped, and then must devise the ways and means whereby these higher standards may be enforced.

This, in the highest sense, is a missionary service, and a missionary service to the rich and poor alike. Much of it rightly belongs to the Department of Public Health. For the benefit of the poor, Maternity Centers must be provided, and the doctor and nurse be paid at least a living wage. We are told that tomorrow we die, and it is equally true that we only live again, in this world, in the coming generation; so what is to be said of a Federal Government that spends each year some six millions of dollars on its agriculture and only some six hundred thousand on its Public Health. Even in this very city of New York, the largest and richest in America, your Maternity Center Association lives as yet solely upon charity, and is carrying on this work of Maternal Welfare until, in the words of Miss Anne A. Stevens, "such time as a demonstration can be made so convincing as to assure for it an adequate appropriation of public money". I say that Maternity Centers, wherever they are needed must be created, and their physicians and their nurses must be adequately paid.

The cost of such a Maternity Center, properly manned and equipped, is not so great after all, even though in a national sense, it is such an important proposition. At the Maternity Hospital Center in Montreal, Dr. J. W. Duncan, the Physician in Charge, tells me that the actual cost of the home delivery, per child, was last year nine dollars and fifty-one cents. At the same time, the amount collected from the mothers averaged six dollars and seventy-two cents, thus leaving a debit balance of two dollars and seventy-nine cents, as the monetary loss to the Center, for each child. Overhead charges were of course, not included here, and the skilled obstetrical service was purely voluntary.

Everyone will admit that the child is our greatest national asset. Irving Fisher tells us that each one of these, new born, is worth, in potential earning power, some ninety dollars to its community; so that, even with Maternity Centers, and with all salaries and all charges paid, the transaction still remains a richly-paying proposition. And all this is not Utopian; it could easily be applied both to our urban and to our rural districts, and it is strictly business, and good business if it comes to that.

Our own immediate share in the transaction—the share of our hospitals and our training schools, — is as I have said to provide the men. These men must have a sound general knowledge of medicine and a special training for this work. And this training must be made broad, practical, and sufficient, if we are to ensure a general improvement in our obstetric art.

Now, if our obstetric practice is to advance at all, it must be along the lines of preventative medicine; and this progress we may define in the following terms:

1. Definite antenatal care.

2. Hospital segregation of the complicated cases.
3. Simple, efficient technique during labor.
4. Postnatal care.

These, I take it, must be the main lines of our advance, and although it all sounds so simple, it really means that the obstetrician must be a master of his subject.

1. *Definite Antenatal Care.* Such care demands both a general and a special knowledge, and means much more than mere pelvic measurements, and a periodic examination of the urine. It must include a general examination of the patient early in her pregnancy, careful antenatal supervision, and a thorough knowledge of the pathology of the pregnant state. There follows then the special examination of the mother and the child at the 30th week, when this child is viable; and the early recognition of the complications which may beset them both. There must also be included a good working knowledge of general hygiene and of public health. Here, as elsewhere, it is "woe unto the specialist who is not also a fair generalist".

2. *Hospital Segregation of the Complicated Cases.* Though I am no special optimist, I believe that these hospitals will, in a short time, — not in Eternity, be provided. In the cities and the older countries, the problem is an easy one; but it becomes possible, with out modern transport even in the newer countries, and with a scattered population. In these hospitals, so far as may be, the various complications, such as the probable dystocias, the toxemias, cases of antenatal hemorrhage, and puerperal sepsis, (when it does occur), are to be segregated, and all the advantages of a hospital service made available in their treatment. Very fortunately for us all, these obstetrical complications, where there be adequate antenatal supervision, give abundant warning of their presence; the sudden, unannounced emergencies are very few, and the good obstetrician is thrice-armed, in that he is fore-warned of the event.

3. *Simple Efficient Technique During Labor.* The prevention of infection is the most urgent problem in obstetrics: it is far more important than operative skill, where 90 per cent of the labors are spontaneous. As we have seen, puerperal sepsis is responsible for as many maternal deaths as are all the other complications put together; accordingly, the first and the most important part of our training is to prevent this sepsis, to furnish the young obstetrician with a good technique. This technique must be simple, must be adequate, and, among the poor, inexpensive; adaptable it must be, and everywhere consistent. Eden happily designates such a simple technique as the "irreducible minimum", and rightly contends that our hospitals should teach in this regard, not only by precept but also by example. One of the dangers of a hospital technique is that it tends to become too elaborate, and too far removed from the possibilities of private practice.

In our Maternity Centers in Montreal, this "irreducible minimum" can be expressed in the following concrete terms. There are to be two night-gowns, four sheets, four pillow-slips, four towels, freshly laundered, and provided, where possible, by the patient. The obstetrical kit from the Maternity Center includes the following sterilized equipment: — a gown and rubber gloves, patient's leggings and vulvar pads, cord and eye dressings, and a few necessary instruments; to these are added, two rubber sheets, a douche can, and two granite-ware basins; lysol, biniodide of mercury, and tincture of iodine are the only antiseptics. Now, with these things, a cake of fresh soap, and boiled water, an irreproachable technique can be attained. All the rest depends upon the personal education, and the correct application of these simple equivalents.

As regards obstetrical procedure, the one important rule is that the parturient vagina should be entered with the same respect as the peritoneal cavity. Abdominal palpation will reveal, not only the presentation, but also the position of the child; the dilatation of the cervix may be learned per rectum, and the heart rate truthfully indicates the condition of the child. A vaginal examination should only be made for good and sufficient reasons, and with the greatest observance of respect.

This rule also carries with it the definite obligation of operative restraint. The ideal delivery is, and must always be, the one that is spontaneous; for, when all is said and done, it is the safe delivery, and in consequence, the ideal to aim at. In a given series of cases it can be shown that the morbidity rate is increased, comes to read as 7 to 4, — by any operative interference: and this fact finds its best illustration perhaps in comparing the exhibition of half a cc. of pituitary extract with delivery by low forceps.

4. *Postnatal Care.* Even as antenatal care is preventative obstetrics so the postnatal care may be described as preventative gynecology. The puerperium is an important phase in the gestation cycle and the involution of the genitalia is a definite process to be carefully safeguarded. At least one postnatal examination must be made, preferably at the 4th week; any trauma, disability, or subinvolution are to be noted; and prompt measures taken for their relief. It goes without saying that operative measures are to be postponed, if possible, till a lactation term is accomplished. In this way we see to it that the genital tract is speedily restored to health, and we ensure for the woman a freedom from future suffering and disablement.

This, then, is the general problem of our obstetrical practice, and it is the first and the most urgent problem that confronts us. It is always a wise thing to begin at the beginning. The true solution of this problem is to improve the general standard of our teaching and so to provide both men and women who will be efficient in this work. In all obstetric practice there are the two outstanding requisites: — the one, the "masterful inactivity" of the well-trained and capable man: and the other is the universal employment of a good technique. It, of course, goes without saying that in this attitude of "inactivity," the obstetrician must always be a master of the situation; and so it is that a sound surgical training is essential, and, added to this, a sufficient skill and experience.

Accordingly, our hospital training should be conducted along these lines, and should not become in any way distracted from the actual needs of the situation.

And yet there is a tendency, I confess, to such distraction. Brilliant surgical interference rather tends to captivate us, and to divert, or even to misdirect, our main attention. The induction of labor in normal cases, and the obliteration of the second stage by version, or prophylactic forceps, do not herald an obstetrical millenium, even though they may be performed by any dextrous surgeon. They are at first sight spectacular and dramatic, and therein is their danger, for they are not safe for general application, In a sense, they provide for the woman a vicarious labor, inasmuch as the obstetrician takes upon himself the main delivery. In very truth, it may be said he labors for her. No, this may be brilliant, but it is not safe obstetrics, and disastrous indeed would be the result if these procedures were generally employed.

I shall now consider four special problems, in obstetrical practice, merely enunciating here the general teaching which we adopt. The methods that I advocate are for the most part old and well tried, for they stand us still in good stead. They are, moreover, safe teaching methods, and they may be applied, both in the hospitals and in private practice.

These four problems are the following:

1. The occipitoposterior position.
2. Eclampsia.
3. Placenta previa.
4. Puerperal infection.

1. *The Occipito-Posterior Position.* Some idea of the frequency of this position may be gathered from the following figures. Last year, in the Montreal Maternity Hospital, there were 1230 confinements, and in 51 of these, the occiput was in the posterior position. Oddly enough, the number of the right and left positions was practically equal, for there were 26 of the one, and 25 of the other. In these 51 cases, there were 22, or nearly half the number, in which the labor was spontaneous. Of these spontaneous cases, in eight good flexion was preserved, and the occiput underwent the long, forward rotation, while in 14 there was loss of flexion, the occiput remained posterior, and the delivery was a face to pubes. The remaining 29 required assistance. This took the form of a manual rotation of the head, followed by low forceps in 13 cases. Here the rotation was brought about by flexing the head by pressure upon the sinciput during a pain, and a manual rotation, the forceps only being applied when this rotation was complete. In 15 cases, this manual rotation failed, and midforceps were required. In these, the blades were applied laterally to

the head, and simply by downward pull, the occiput undertook of itself the rotation forward. A second application of the blades was necessary after this rotation had occurred, to finally deliver the head. In 14 of these cases, the occiput led in the rotation, and the forceps' blades were simply allowed to follow in this movement. In only one case was a definite Scanzoni, that is, an induction of the rotation by the blades themselves, found necessary.

A median episiotomy was done in all the face to pubes cases, and in but two of these were the sphincter and muscle torn through. In them all, repair was satisfactory; in only one case was the puerperium morbid, while there was no mortality among the children.

Now, in all fairness, these results are satisfactory, albeit the methods pursued represent a minimum of interference. Though it is possible, in many instances, to identify these posterior positions by external palpation, before, or at the beginning of labor, it is probably safer to leave them alone. A version is scarcely necessary, save there be some pelvic contraction; and the same may be said of Buist's external rotation of the anterior shoulder, or the internal rotation of this same shoulder by the excellent manoeuver of Pomeroy.

2. *Eclampsia.* The eclamptic condition will rarely develop if there be adequate prenatal care. It can largely be checked by starvation, as witness the results in the Great War. Now and then, however, we meet the fulminating case—the convulsion is like a bolt from the blue—; and there are many cases where there has been little or no supervision.

Last year we had 14 such cases of eclampsia, and in only one of these did the mother succumb, and this from a bronchopneumonia on the 17th day after her delivery. In seven cases the labor was spontaneous, in one the patient was admitted postpartum, and in the remaining six, the labor was later induced by the Champetier de Ribes', or the Voorhees bag. In none of these cases was a cesarean section undertaken. Six of the children were premature, and of the full-time children, four were still born. In all, eight children survived, and two of these were twins.

I believe it is wise in these cases to treat the eclamptic condition, leaving the labor to care for itself. In my judgment, the definite routine of immediate delivery is a great mistake. Rather shall we first treat the actual eclamptic condition, and in the following way.

There is no doubt whatever that convulsions kill, and in consequence these must be controlled by a free use of morphia. One quarter of a grain is first given hypodermically and this is repeated, if necessary. If possible, a specimen of urine is secured, to verify the diagnosis in the emergency case. A venesection is done, and sufficient blood removed to reduce the blood pressure to a normal reading, say 130. The stomach is washed out with a solution of bicarbonate of soda, and one ounce of magnesium sulphate, in saturated solution, is left in the stomach; the rectum is emptied, and this is followed by high-colon lavage, with the same alkaline solution. Hot packs were not employed, though the Burdick's Electric Bath was used in several of the cases.

Under this treatment the condition of these 14 patients gradually improved; consciousness was regained, the fits ceased, and the flow of urine was re-established. Forced fluids were administered by mouth, and per rectum; and in three of the most severe cases, 10 ounces of a normal glucose solution was given intravenously for three days. All these patients recovered, save the one who died later of bronchopneumonia. This recovery was always gradual, a matter of days in each case, and it was denoted by a controlled blood pressure, a steadily clearing consciousness, an increased output of urine, and the diminution therein of the albumen and casts.

As I have said, in seven of these cases, labor spontaneously supervened. The remaining six improved so far, and then failed to establish a further improvement. So soon as this maximum improvement was reached, as indicated by blood pressure, urine findings, eye-grounds, and general condition, the labor in each case was induced.

The results in the 14 cases were that 13 mothers and eight children survived; and so I conclude that the above was not an unwise procedure in these cases.

It was interesting to observe that in these improved cases, a mild eclamptic condition was always induced by the labor. This was occasioned no doubt by the heightened metabolism and the additional toxemia, consequent upon the strain of labor; and added to these, the necessary anesthetic. In no case did actual fits occur, but the condition was pronounced enough to convince one of the wisdom of the delay.

3. *Placenta Previa.* In the present series, the placenta was previa in eight cases, all multiparae, but in only two was the implantation central, or nearly so. In one, it was marginal, and in five lateral, on the lower uterine segment. In six of the cases, pregnancy had reached term, as nearly as could be estimated; while in the other two, the thirtieth week was about its duration. Two of the children presented by the breech, and in all the others the presenting part was the vertex. In three of these vertex cases, on their admission to hospital, the cervical canal was sufficiently dilated to permit the immediate introduction of the hand, and the performance of a podalic version; and it was in two of these that the placenta was centrally placed. In the other three vertex cases, there was but little dilation, and a bag was inserted in the intraovular position. The breech presentations, on admission, revealed a cervical canal the size of a finger. A manual dilatation was immediately performed, the membranes ruptured, and the anterior leg brought down into the vagina. In one of these cases, the mother was practically exsanguinated on her admission, and her child was dead. Though the bleeding was immediately controlled

by the above manoeuver, despite all stimulation, intravenous and otherwise, she succumbed, in two-and-a-half hours after admission.

Of the children, four were lost, and it is only fair to say that two of these four were premature.

The total result of this small series is that in the eight cases, seven mothers and four children survived.

In respect of placenta previa, the following rules are to be observed.

1. This first rule concerns itself with diagnosis. If a uterine hemorrhage occur during the last trimester of pregnancy, and be not associated with uterine pain, there is probably a low implanation of the placenta. If the blood pressure be not elevated, and there be no albumen or casts in the urine, this probability is strengthened, though in actual diagnosis can only be made by means of a vaginal examination. If the placenta occupy the lower uterine segment, it can usually be felt as a definite sponge like structure, underlying the presenting part of the child, which, in consequence, lies unusually high, and is frequently somewhat laterally placed. The vagina appears long, the cervix is reached with some difficulty, and the lower uterine segment is thick and vascular.

2. Now, given a single uterine hemorrhage and this diagnosis made, there is no doubt that the sooner delivery is effected, the better. Successive hemorrhages tend to increase in severity, and even in a hospital, assistance is not always immediate.

3. If the implantation be central, or nearly so, and the child be alive, either at term or viable, I believe that a cesarean section, in multipara and primipara alike, is the wise procedure, provided always that good surgical conditions can be secured.

4. In private practice, where rubber induction-bags are seldom available, a firm gauze pack in the vagina, the application of an abdominal binder, and a hypodermic of a sixth of morphia, will ensure a period of safety, in which extra help may be procured, or the patient be moved to a hospital. If delivery must be undertaken in her own home, this vaginal pack is invaluable. By its means, the hemorrhage may be controlled, using, if necessary, successive packs until sufficient dilatation of the cervical canal be secured. The membranes may then be ruptured, and the descent of the presenting part promoted by means of an abdominal binder; or a podalic version immediately performed.

4. *Puerperal Infection.* This is a wound infection, for the puerpera is a wounded woman—wounded, mainly, at the placental site. The organisms are chiefly the hemolytic strains of the streptococcus, though in rare cases the staphylococcus is the causative agent. These organisms are present everywhere, on skin and mucous surface, where they exist as saprophytes; and they are specially numerous in the region of the vulva and perineum. For this perineal abundance, Victor Bonney blames the anus, and contends that its propinquity to the birth canal represents a

grave defect in our development. He mourns that there is no likelihood of any immediate change in this arrangement. These organisms may be resident in the vagina, even of the healthy parturient, though the abundant secretion, its acid reaction, and an acquired specific immunity, tend to speedily attenuate their virulence.

In each and every case the greatest danger is always from without, and with fresh strains—stranger ones of these organisms.

As we all know, these facultative saprophytes, are a menace only when there is a recent wound, for then they may become a parasite, and acquire sufficient virulence to make them pathogenic. Objectionable aliens they always are, and are never to be trusted. Innocent here and today, and virulent there and tomorrow, they are the cause of many wound infections, the severe types of peritonitis, of erysipelas, and they seriously complicate, to say the least, the throat conditions of diphtheria, measles, and scarlet fever. Transferred from one individual to another, they frequently gain exalted virulence, so that, in merely swabbing a mildly infected throat, or in dressing an infected finger, the expectant mother may, by so doing, sign her own death-warrant.

Accordingly, during the final weeks of a pregnancy, there is need of a careful prophylaxis. So far as may be, the mother must be protected from all sources of infection; in particular, she should be isolated from all zymotic disease. There should be special cleanliness exercised about the vulva and perineum, and there must of course be no sexual intercourse whatever.

As I have said, the place of greatest danger is from without, and now the time of greatest danger is at the time of labor. If, as a result of careless vaginal examination, or operative interference, these organisms are implanted within the vagina, or upon the surface, they may soon infect a cervical tear, or even a placental site, while these wounds are fresh, and still unprotected by any reactionary tissue. The most dangerous time is the first 48 hours, for then these wounds are most vulnerable, and the woman's sole protection is the flow of fresh bactericidal blood, and the pregnancy leucocytosis. This, then, is the time of greatest risk, and the danger always is the untimely entrance of these organisms into the wounded zone.

Credé puts the case well when he says:—Limit as far as possible puerperal wounds, be restrained and gentle in all manipulations; and do not infect these wounds, or permit them to become infected. And so we are brought back again in the conduct of any labor to the "masterful inactivity," and the good technique.

The management of a third stage is also of first importance. This third stage is a miniature labor, and like the larger labor must, if possible, be spontaneous. After the expulsion of the child, the uterus is fatigued, and ample time must be given in which it may retract and recover. Its tone and its activity must in a measure be restored before it can undertake the separation and expulsion of the placenta, and the timely control of the hemorrhage by a sufficiently firm grasp of the vessels. This time varies greatly in different cases, so one must not be mindful of the clock, since the uterus itself is the only trustworthy timepiece. It is always correct, always tells the right and proper time, by manifesting its strong and regular contractions. Postpartum hemorrhage is most often the fault of the too-impatient physician than of the too-patient uterus. Moreover, a premature Credé may raggedly separate the placenta, and a cotyledon, or large portion of the membranes, be left behind, with all the consequent risks of hemorrhage and infection. Such a hurried and, so, incomplete emptying of the uterus, undoubtedly explains the relationship that exists between the length of this third stage and the number of the organisms, and the time of their appearance within the puerperal uterus. As you know, the puerperal uterus is usually sterile only for the first 48 hours after delivery. The investigations of Ahlfeld and Walthard have shown that in a given series of cases a uniformly short third stage implies frequent manual assistance, and that in these cases this uterine flora appears earlier and is more abundant; that measured in terms of time, a third stage, approaching an hour in duration is safest in this respect, and is, in consequence, more likely to be followed by a nonmorbid puerperium. The lesson here again is to wait in each case for the uterine recovery, and save for good and sufficient reasons, never to hurry the third stage.

A careful inspection of the secundines is imperative, special attention being paid to the cotyledons, and to the margin of the placenta for the presence of torn vessels,—the evidence of a succenturiate lobe.

Now, all this is prophylaxis, and we cannot sufficiently emphasize its importance, since in every case the proper treatment of childbed fever is to prevent it. And yet, even in the best-regulated clinical families, it does occur. Last year, in the Montreal Maternity Hospital, with its 1230 deliveries, there were in all, 10 deaths,—a mortality rate of 0.81 per cent. Seven of these deaths occurred within 24 hours of admission, and of these, two were admitted with a ruptured uterus, one with a pleural empyema, one with an eclamptic toxemia, two with a myocarditis and failing compensation, and one with an exsanguinated placenta previa case. There were two deaths from puerperal infection. In one, the labor was spontaneous, only a rectal examination was made, and yet the patient died on the 9th day from a streptococcic infection, and we were altogether unable to account for its occurrence. In the second case, a cesarean section was done in a severe toxemia, and though the child was saved, the mother died on the 4th day, from a septic peritonitis.

The morbidity rate, during the same year,—measured by the high standard of a single rise of temperature from any cause, to 100.6° F., during the 12 or 14 days stay in Hospital, was 19.1 per cent. It is only fair to add that in nearly half of these cases, in 8.5 per cent, the fever was due to extragenital causes.

And now, the treatment. Here there still remains a sharp divergence of opinion. The whole problem is in the nutshell of whether to enter, or not, the infected uterus.

Our own rule in these cases is this: — if the case have been delivered under our own care or supervision, and we are in consequence reasonably sure that the uterus is empty, we never enter an infected uterus, save for the control of hemorrhage. It is never safe to break through the reactionary zone in any septic wound, to so attack the infection, as it were, from behind; and, in this uterine situation, we cannot attack it in front. Accordingly, it is much safer to make no local attack whatever.

To this general rule of noninterference, I am willing to concede the following exceptions. If the case has been seen only postpartum, and the history of the third stage be indefinite as to a perfunctory examination of the secundines; if the clinical findings bespeak something retained *in utero*; namely, a foul and abundant lochia, a large, soft, moveable uterus, a patulous internal os, easily admitting the finger, at, or after, the 4th day, and the fever be intermittent in type, it is permissible, I believe, to enter the uterus, but only with the finger, and to remove therewith any considerable placental fragment. A uterine curette, sharp or blunt, is never used, and even an intrauterine douche is never given.

There is then, generally, no local treatment, though good uterine drainage is secured by the Fowler position, the icebag over the fundus, and the exhibition of hydrastin, or of ergot and strychnin.

If the infection be severe and systemic in type, 90 cc. of the polyvalent, antistreptococcic serum may be administered, at one time, but in divided doses. The hope is that these strains correspond, and that a beneficent adsorptive neutralization of the toxins be so brought about.

Vaccines have no place in these acute cases, for the patient is already more than sufficiently vaccinated.

An attempt may be made to stimulate the resistance of the patient, to awaken or increase the nonspecific antibodies, by the intravenous injections of various chemicals, or of animal, or vegetable proteins. Nucleic acid is one of the latest of these. Long ago, Credé began with formalin and collargol, and the name of the reagents is legion. Dr. H. C. Burgess, one of my colleagues, has great faith in eusol: — 2 ounces of a carefully titrated solution being added to 10 ounces of normal saline, and given intravenously, every second day. I have never been able to convince myself that any of these substances have any specific value, or that they are superior in any way to a plain glucose solution, a saline solution, or even distilled water.

The general treatment is summed up in the following directions.

Feed the patient, and force the fluid, by the mouth if possible, and, where necessary, by the rectum. Secure an abundance of fresh air, and, above all, satisfying sleep.

Mr. Chairman, may I thank you, the Alumni of this great Hospital, for the honor of speaking before you. We are all engaged together upon this great service, — the prevention and the cure of disability and disease. In a true sense, our hospital and our training schools must be the "proving grounds" of clinical experience. What is found good, we select and teach, holding fast only to that which is true.

At the same time, our duty is to advance our knowledge, and to encourage research; for we remember that it is only with a right conjunction of special thought with action, of science with art, that we can become a growing-point, — a growing point in our profession.

Our special service here is to provide, as near as may be, a universal Yea, to the mother and her child. "Is it well with the child?" And, by reason of our service, the mother herself may make answer, "With myself and my child, it is well."

Discussion

Dr. A. B. Davis: "The Lying-In Hospital is one of the institutions that are attempting to do what Dr. Chipman has mentioned, namely, making of obstetrics safer, to have a better knowledge of how that is to be brought about, and to diffuse that knowledge, not only in the great centers, but where it is especially needed, in the sparsely-settled regions of the country where the doctor must be the obstetrician, the surgeon, the eye-specialist and what not, and where time is important and sufficient care cannot be given to these things to have them well done. The speaker has indicated that the centralization or hospitalization of these complicated cases is now made possible even in the sparsely-settled parts of the country by means of the telephone and automobile and probably in the near future the wireless.

The whole tone of Dr. Chipman's paper has been of a conservative character, not teaching a radical improvement upon nature, for we find that the simpler we can make this obstetric practice the safer it is. We may do brilliant surgical work, but many cases will take care of themselves if they are left to themselves. Nevertheless, we have to be on the alert because there comes a time in some of them when it is essential to step in and step in quickly and with knowledge.

"Obstetrical conditions in this country as a whole are deplorable. That is, I think that when we realize we stand fourteenth, or nearly at the bottom of a list of eighteen countries where statistics are gathered, it does not reflect favorably upon our intelligence or on our good business sense. However, we know that conditions are growing decidedly better. Anybody who has watched obstetrical developments in the last twenty-five years in this and other cities cannot, it seems to me, escape that. In the different maternity hospitals in this city the total results are not so very different one from the other, and I am very sure that there has been a great improvement. At the Lying-In we used to see more septic cases. We knew probably as much about septic cases as is known in other hopsitals because we saw them all the time and we saw all phases of them. We saw them die. We treated them in many ways but they would die. We do not now see these septic cases. We do not see sufficient septic cases, certainly not in the Lying-In Hospital (and I believe that is true of other hospitals), to give the younger men who are coming up an idea of what sepsis may be, and because of that I think there is going to be some weakness in our training. We do not see them in consultation in private practice as we did ten years ago. I believe they do not occur. We do not see cases of eclampsia as we formerly did. We have not had a dozen well-marked cases of eclampsia in the Lying-In Hospital service in the past year out of 5,000 or 6,000 cases. That is probably true of the other hospitals. As I say, the maternity hospitals do not differ so much one from the other, and when we do get cases that are infected we have tried out serums, intravenous injections, transfusions and intrauterine treatments, and have found that by and large if we put them up on the roof, elevate the head of the bed, put on an ice bag and forget them, by which I do not mean actually forgetting them, but not interfering with them, they get well in a very large percentage of instances, if there is any chance for them to get well. We do not lose what few septic cases we have.

Dr. William E. Studdiford: "There are one or two points to which one could possibly add a little emphasis. His first statement that parturition was the same in the cow and the countess, was perfectly true up to one point. Now, with the cow, as I understand it, if the cow cannot stand on its legs within a few hours after birth, they kill it because they know that such a calf is of no use so far as the rest of the herd is concerned. Now, that is not true of the countess. We spend a lot of time on bringing up premature babies and in trying to get the countess to produce something that is really worth while, and we often wonder whether it is worth all the time and money expended. That is one point. On the other hand, there is no question but that obstetrics is a good deal in the situation that gynecology was when Dr. Chipman and I started out to study gynecology and obstetrics. It was very difficult to get people to go to the hospital. I can well remember doing an extrauterine pregnancy on an ironing board over a bath tub up in a tenement house. The patient got well. Today we have no such difficulties, and we have only to mention that the patient has a surgical condition and the patient asks, 'When do I go to the hospital, and when do you operate?' Now, obstetrics has not gotten to that point and the objective that must be necessary in the complicated cases. Granted that 90 per cent. of cases are normal, it requires a lot of antepartum and antenatal work to determine that condition, and the condition of the patient must be determined before she goes into labor. The complications of labor and the complications of the postpartum state are due very frequently to faulty antepartum work. The patient should come up to her labor with a very definite idea on the part of the attendant as to what the possibilities are. There is a certain number of cases in which you believe the case will be a normal one, but it turns out to be abnormal. It may be complicated, but there are other cases in which you are in doubt the minute the patient appears before you. You question the possibilities of the woman's labor. Adequate provision should be made before hand as to the handling of such cases.

"Dr. Chipman has not mentioned statistics as to infant mortality. Investigations made very thoroughly lately in England show that probably over 50 per cent. of the infant mortality, is due to ante-natal conditions; that 50 per cent. of infant mortality is due to some accident in the course of labor. Leaving out the morbidity due to syphilis of 15 or 20 per cent., it leaves a small balance from unknown causes, but you have a tremendous mortality due to labor.

"Now, as to the question of prolonging the labor. It is all very well to say you have an occipitoposterior. Having satisfied yourself that you have an occipitoposterior with the possibilities of a normal delivery, it is well to assume a position of watchful waiting. On the other hand the woman with a prolonged first stage with no effort to advance should be given a thorough examination under an anesthetic to determine the best procedure to follow and not have to do it as an emergency after the woman is exhausted, with resultant morbidity both to the mother and to the child.

"In regard to the question of the toxemias of pregnancy. There is no question that many of these cases are due to some fault in the individual. While pregnancy and parturition are a normal condition, we find women who have some deviation, either as to their circulatory or their kidney condition, that under the strain of pregnancy breaks down and you have evidences of toxemia, possibly the result of a scarlet fever, rheumatism or tonsillitis. With the recent advances in the care of contagious diseases, the better care of the throat and the infectious conditions together with the removal of tonsils, there should in the future be a diminution in eclampsia because you should produce women with less injury possibly to their kidneys and heart and less risk from total infection.

"One of the first questions asked me when I went to the Sloane Maternity Hospital was as to the routine treatment of eclampsia. My answer was 'Gentlemen, I'll be condemned if I know.' I do not know any routine treatment for eclampsia. I do know that many of these women that come down there with either a threatened or an actual eclampsia, are under a tremendous nervous strain and that before anything is done toward the termination of pregnancy, the quieting of the nervous system is essential. Having done that, you have the opportunity of deciding the best policy to follow; and the same way in the handling of these cases outside of the great cities where you have hospital facilities. Within the past month I have been talking with some of the men in the State Health Department on the question of maternity work outside of New York in the rural districts. There is no question, if you are going to handle the proposition, that hospital facilities must be available; that every woman who has lost her child or her first baby by some accident in the course of pregnancy should be advised and brought for a thorough examination by competent physicians, and if she becomes pregnant again, she should have the advantage of some hospital treatment. I understand that in England they have established in various communities what are called cottage sanitaria, which are simply treating stations, the severe cases being taken to the larger hospitals for control. I believe that some such plan must be developed here if we are to develop our obstetric practice. It is not only a question of physicians, but also of trained attendants and the careful following up of all women who are pregnant until you determine just what their condition is.

"In the handling of your labor cases it is not only in your postpartum work that you do preventive gynecology, but it is in the handling of labor. That is preventive gynecology. If you have a prolonged labor and the baby is dragged through with forceps and the patient is torn both anteriorly and posteriorly, there is surely going to be gynecologic treatment. That method of delivery must be prevented if you are going to handle these cases properly, and the question of forceps, version, etc., must be in the armamentarium of every one doing obstetrics; also the possibility of doing abdominal work."

Dr. George G. Ward: "I wish to thank Dr. Chipman for sounding such a conservative and sound note, especially at a time when radicalism has been reaching out in certain directions. One of the great functions of the Lying-In Society, it seems to me, is to propagate the teaching as Dr. Chipman has given because your work is spread throughout the community. The numerous men that come to you for your lectures in obstetric training are the ones that are going to do the work in the homes and it must, therefore, carry great weight what is said at meetings of this kind.

I asked Dr. Lyon, of the Woman's Hospital, to let me have the results they have been obtaining in the Obstetrical Department in toxemia cases recently. One point that he brought out was that in the past sixteen months Dr. Dorman has been sending in to the hospital all cases which show any evidence of toxemia in the prenatal clinic so that the cases might be treated in the hospital and not treated as ambulatory cases at home. The results so far have certainly been satisfactory, in that in the two previous years there were only two cases of toxemia from the antepartum clinic. In the last 16 months in which this method has been adopted there have been no cases that have developed eclampsia. In other words, careful prenatal care, sending the patients into the hospital for proper supervision of the treatment which has been laid down, seeing that it is properly carried out, in the short time this has been in vogue has given us results that make it worth while.

"One point I was glad to hear brought out was the mention of the postnatal care of cases. We hear a great deal about prenatal clinics and prenatal care. I believe that postnatal care is also important. While I do not wish to minimize the primary importance of prenatal care, still, as a prophylactic feature, I believe postnatal care is certainly very important in relation to the obstetrical and the gynecological side.

"In the Woman's Hospital we have established a very efficient follow-up clinic in the Obstetrical, as well as in the Gynecological Department. We, of course, appreciate that the obstetrical follow-up is an entirely different thing than the gynecological follow-up. It is not possible to control these women for the same length of time, nor is it necessary, as a rule, but the trial we have given has proved satisfactory in the two and a half years that we have had it. We have all the cases come back three times, at the end of the first, second and third month, at which times they and their babies are also examined.

"One of the points of particular interest is the proportion of cases having retrodisplacements after labor. That, you see, directly affects the pathological side of the problem, and in this follow-up which we have had in the last two and a half years our figures show that there are some 6.9 per cent. of cases with retrodisplacements at the time of discharge from the follow-up at the end of the third month. That is to say, the cases had retrodisplacements which we felt should receive further attention, and they were accordingly thereafter referred to the Gynecological Department for correction or treatment of that condition. We cannot, of course, tell exactly what percentage of those retrodisplacements developed in our clinic because many of them may have been present and existing before the woman was pregnant in this particular labor. That is hard to say, but we can form an opinion as to the necessity of watching this feature when we realize, as far as we can estimate, that in approximately 30 per cent., of all the cases coming into the follow-up we find it necessary to use a retroversion pessary and that the great proportion of those cases are corrected by the use of this pessary during these three months. I think that points out the very great importance of the general practitioner remembering that the prophylaxis of retrodisplacements lies in following labor and also in following miscarriage because they occur just as frequently after miscarriage for the reason that we have a large uterus at three months with lengthened guy ropes to the round ligaments, and when the uterus is emptied we have a top heavy organ. If the obstetrician does his full duty he will try to keep track of his cases until he is sure the uterus will stay up. That means if it won't stay up, he should use a pessary. The idea that the pessary is of no further use and that everything should be done by surgery is absurd. It is one of the most valuable aids we have as a prophylactic measure in these cases, and I would, therefore, urge in the teaching that stress be laid on the importance of the post-, as well as the prenatal follow-up of these cases."

Dr. Robert L. Dickinson: "My hobby at present is maternities, and Dr. Davis gave me the opening that Dr. Chipman did not. Otherwise, it might not be relevant and regular to bring it out. He said that the results obtained in our maternities were such and so high a standard that we are more or less upon an even high standard. Now, it has been my privilege to be invited to a number of staff reviews and to look over the results of a number of hospitals, maternities in this city and in other cities and the surprising thing which I have noted is the inequality of those results.

"Now, I take it that we all know we are not always calling the same things by the same names. If I say that in this hospital the stillbirths are so and so many, such and such a per cent., and in that hospital the stillbirths are very much less, I ask the question at once, What do you call a stillbirth? Are you including your abortions and your miscarriages in the stillbirths? If you are, then those two are not comparable. We should call things by their proper names. That is the reason, or part of the reason, why the Public Health Committee of the Academy of Medicine reported such an astounding difference of maternities with a very low mortality and a very low still birth rate and a very low neonatal rate, whereas some of the public welfare results, such as Bellevue and Allied Hospitals and also the general hospitals, were very high, the reason being that their methods of making returns are not always the same. Therefore, before beginning to make such comparisons, we should adjust our standards to conform with those of some leading body like the A. M. A. or the American College of Surgeons, and so standardize our methods of making returns that we will know what we are talking about and have a uniform basis from which proper conclusions may be drawn.

"I would like to report that in going about and talking over this matter I find a very great watchfulness and alertness on the part of trustess of hospitals on this subject of obstetrical accounting. They call in a certified accountant and say to him, Are these figures all right? Are our returns up to the average standard? We can take some examples. We can say that hysterectomies for fibroids should show a mortality in a large series of cases of somewhere between the best results obtained, like the Mayos and the Woman's Hospital, and some of the best places where it runs below 1.5, and some of the other hospitals where it runs above 2 or close to 3 or above 3 per cent. Many cases are being operated on and subjected to unwise surgical judgment, or poor surgery is being done.

"Can we apply some of these simple yard sticks to obstetrics? Yes. Let us remember that there are maternities and maternities. There is the maternity that is the dumping ground for bad cases. It will have a lot of sepsis and a lot of abnormalities sent into it, like some of the public welfare institutions, with the result that the mortality will be high. There are some private maternities where there is the best of prenatal care and the best of obstetrics. Such institutions will show a low maternal mortality. We must not compare those two unlike things, but should make necessary allowances when we are talking about statistics.

"If your obstetrical mortality is above a certain figure, you must do what for your cases? You must analyze them. There is no such thing as talking about statistics unstudied and comparing one case with the other. Every death, every sepsis, every complication must be studied. But you may say that that is an awful job. It is not. It only takes a few cases. I go into a hospital at the request of the trustees in some outlying town and what do I find? Caesarean cases—so many—very high mortality—every one of them infected—a large percentage of caesarean cases, in the first place, 4 or 5 per cent. instead of ½ or 1 per cent. Bad results when they are operated on. Eclampsias not treated conservatively, but radically,—high mortality. Taking a few such cases and a very small group of a dozen histories, you find the reason for so many stillbirths. The time is coming when the American Gynecological Society or some other organization such as the New York Obstetrical Society, will take it upon itself to go about a small group of maternities and determine whether we ourselves are not calling the country practitioner and the midwives names when our own skirts are not entirely clear. That is a scheme that is bound to come, and thereby we will raise our own standards. You may not need it perhaps. But the little hospital, the weak hospital does need it. There is nothing ever happened to us in Brooklyn Hospital more valuable than our staff reviews whereby we honestly analyzed our deaths. We used to be able to dodge, but we cannot with the interns and all the dispensary staff present. The whole staff is there to analyze our cases for us, to make our excuses, too.

"Now, there are two kinds of staff reviews. There is the criminal court where the doctor is called up and thoroughly ragged because he lost a patient, and there is the whitewashing committee that simply smooths it over and says, 'Oh, yes, it is quite all right; we understand.' There are places where the histories are not brought forward, and there are places where you take it on what the man says the cases are. Then there are all those questions of what you will do with the private case which you do not wish to exhibit publicly. Everybody knows that the wife of the trustee or the wife of the magnate went bad. Will you exhibit that whole story so that it comes out? Where does private confidence come in and where does it stop? In other words, I feel that the next great move, not only in obstetrics, but in the progress of all medicine is some of this surgical accounting; and I can only feel but what our professor from Montreal must know, that the greatest obstetrical educational force in America is the Lying-In Hospital with the drive it has made upon midwives, with the innumerable men it has sent out to teach and to do good obstetrics and to take part in that movement."

Dr. Ralph H. Pomeroy: "I suppose that I am one of the radicals that Dr. Chipman objects to. Now, those of us who have taught students, and I have had my apprenticeship and my tryout, and I think I can teach students as well as apprenticeships, my experience has convinced me that there is an absolute necessity for recognizing before long, if not now, a distinction between midwifery and surgical obstetrics that belongs in the same class as gynecology.

"Now, Dr. Chipman has presented the usual statement, most beautifully expressed, that stands for the teaching that we give to the student and to the midwife. It is absolutely necessary that such standards should be expressed and taught and inculcated and drilled into the general practitioner.

"Dr. Chipman speaks of the cases that occur in general practice, but he does not speak of the cases that occur in high grade hospital practice, in which the patient is observed either as a private or an outpatient, has prenatal care from the beginning and is sent through with a view to seeing that that individual patient goes into and through her labor non-toxic, that she goes through her labor unfrightened and undamaged and comes out of it ready and willing and able to have another child.

"Now, that is not the result of the 90 per cent. spontaneous deliveries that Dr. Chipman is talking about and telling the student and the midwife how to take care of in the sense that the woman lives and the child lives. The point of view is totally different from that which is often presented by the prenatal care and the maternity center in which I am tremendously interested. Those enterprises are largely centered around the proposition of child welfare, not mother welfare, and all the legislation and all the public discussion and all the governmental control in the situation seems to center about the question of how shall we raise perfect children.

"I contend that it is a necessary and proper thought in obstetrics that we should learn how to take care of the mother in the best manner that can be thought of, and that is not midwifery.

"I am perfectly willing to think that I am inadequate to this situation. I am perfectly willing to think that the only way I can get to Dr. Chipman would be to go to Montreal and spend six hours in telling him how many things I do not agree with him on, and that does not mean that I do not admire his proposition. But I cannot agree with his proposition when he tells me that the normal way to manage the third stage is to let it go for an hour. That is perfectly good midwifery but not good surgical obstetrics, and therein lies the difference between midwifery and surgical obstetrics. It does not mean that I want to do one out of every thirteen of my deliveries *a la* Potter, by cesarean section, and the rest by extraction, but I do want to consider the welfare of the patient and the problem of the posterior position in some other term than fifty-one identified posterior positions out of twelve hundred deliveries."

Dr. George L. Brodhead: "Dr. Chipman made a reference to the general surgeon who can do two or three hundred cases perhaps without a death from sepsis. Now, I think the proposition of the general surgeon is a very different proposition from the man doing general practice in obstetrics. The general surgeon can take his patient to the hospital, he has the patient under complete anesthesia, he has assistants and nurses, and I think his mortality should be better than that of the man doing general obstetrics, especially when his work has to be done among the poorer people in the tenements. I think the general practitioner doing obstetrics has a very hard time of it, and I am surprised that his mortality figures are not higher.

"I believe we should take every precaution not to infect our patients. I agree absolutely that the rectal examination is in most cases sufficient. For a number of years in our hospital and private work we have used that, only making vaginal examinations in cases where they are absolutely indicated. I think that is a step in the right direction.

"In reference to the prophylactic forceps. I do not know whether I do the prophylactic forceps or not, but I know in my private work in primiparae I use the low forceps operation in 60 to 70 per cent. of primiparae, and I believe that I can get better results by doing that with the head well in the pelvis and the cervix obliterated than by allowing the patient to go on, as she will in a great many cases, hour after hour making absolutely no advance.

"In the occipitoposterior positions, it just happened that my early training was in the use of the Scanzoni maneuver, and for some twenty-five years I have used the Scanzoni manoeuver with forceps with, I think, the very best of success. It is purely a matter of training. There is absolutely no objection to the use of manual rotation.

"In eclampsia, I believe the doctor is absolutely on the right track, that conservative treatment is undoubtedly the best treatment in eclampsia.

"I wondered when he read his statistics why he induced labor at all when the patients' condition became so much better. It seems to me if there is an indication for induction of labor when the patients are so much better that there might be a better indication for emptying the uterus when they are having convulsion after convulsion, as they do, and resisting all the treatment that we are giving them.

"In regard to placenta previa, certainly in the cities there is no difficulty at all in keeping a supply of de Ribes bags in good condition. If they are properly taken care of they last a long time. It seems to me that the treatment of placenta previa of the marginal variety that the bag is eminently the best plan of procedure. I think it is the quickest, the safest and the easiest, provided it is properly done.

"In regard to the third stage, I do not understand that Dr. Chipman advised us to wait for an hour before trying to express the placenta. I know if we do that in a good many cases the patient will lose a tremendous amount of blood. It is astounding how much blood will accumulate in these uteri with very moderate external bleeding, and I think the watching of the uterus very, very carefully and using the Crede method fifteen to thirty minutes postpartum is probably the correct procedure.

"The doctor mentioned inspecting the placenta and membranes. Now, as a matter of fact, clinically, retained portions of placenta are very rare. Certainly in a group of 20,000 cases I do not recall ever having seen a placenta succenturiata retained. It almost always comes away.

"With regard to retention of the membranes, while I think it is important scientifically to look over the placenta and membranes, I believe it is of very little importance whether a portion of membranes is retained or not, and, personally, if the entire chorion is left I would not think of invading the uterus to get the chorion out; so I think the inspection of the placenta is more a matter of scientific interest."

Dr. Harold Bailey: "I feel that the old forms of treatment cited in the paper are the ones we will have to stick to, and if we start teaching this operative surgery in obstetrics we will have a great deal more mortality both for the mother and the child.

"I was particularly interested in what the doctor had to say about sepsis. As very little has been said upon that subject, and as we have had considerable experience in that respect in the last year, I think it is worthy of some comment to note that not only apparently in this end of the country, but all over the registration area there has been a great increase in sepsis in the past year, or past two years, and in New York City, during the time in which the maternity centers have been running some 10,000 cases we have had a great many and they centered for the most part in two or three of the city hospitals, one of which I was connected with. Now, in analyzing the cases somewhat along the line that Dr. Dickinson has mentioned, we find that notwithstanding the great number of cases and the number of deaths that we had in this maternity center group, still it was two points per 10,000 less than in the Borough of Manhattan itself, and I received a communication the other day from the State Department of Health and I find in the same year outside of the Borough of Manhattan it was as high as it was in the maternity center group.

"I believe it is very well to study these cases in large groups, and it so happens that our sepsis rate in this maternity center group was exactly the same that Dr. Chipman had, or nearly so, in his 1,200 cases.

"In regard to the follow-up of these cases, I think a very good note was sounded in the discussion concerning the postnatal clinic, and during the past year or a little over we have had two or three clinics a week, one of them being a postnatal clinic."

Dr. Ralph M. Beach: "There is just one point that I would like to emphasize. We have been following our cases with rectal examinations in the last few years and we believe we have had less morbidity since we have been using that procedure. We have been surprised with the accuracy of diagnosis that we have been able to acquire by means of the rectal examination, and have only used vaginal examinations in cases where we were in doubt.

"Now, in analyzing our septic cases where we did only rectal examinations we have been struck by one important factor which Dr. Chipman brought out as an etiological factor and that is intercourse. I do not think enough stress is laid by the doctor on the danger of intercourse late in pregnancy. We recently had in one of our hospitals a case in which no vaginal examinations had been made. The woman's husband came home and twenty-four hours before the woman went into labor he had intercourse with her and she died in seven or eight days of a virulent sepsis. We have taken all our septic cases where we could eliminate ourselves as factors of infection and in the majority of cases intercourse has been the factor. It is not enough to say to a husband, 'When did you have intercourse last?' You have got to say, 'You had intercourse recently, didn't you?' I have repeatedly elicited a statement from husbands that they had intercourse within the last six days. I do not think enough stress is laid on this factor in our clinics and in our private cases. Every private and every clinic case should be instructed of the danger of intercourse late in pregnancy. I tell my people to abstain for two months before and then I am pretty sure they will stay away for a month."

Dr. W. W. Chipman: "My general attitude is one of humility because these figures which I have given you are, after all, very small in number, and I knew so well how your centers here and your larger institutions provided for you so many greater facilities, but such as they are, I have given them to you.

"Now, it is gratifying to find, after all, that even Dr. Pomeroy and myself, and Dr. Brodhead, too, are very much in unison. I see the point he makes and I am quite willing to adapt myself in a certain measure to it. We pay a large price for our civilization perhaps, and it seems to me that in the future we are perhaps likely to pay a still larger price. Certainly as regards our well-to-do or our rich people, they are pleasureloving and the girl comes up to her labor ill prepared: she is not trained morally, mentally or physically, at least not always in Montreal, and that training is very important. I believe the endocrine insufficiency plays a part in it. Then perhaps it is too much to ask her to go through a normal labor. She is an exotic, if you like. She may be worth perpetuating her species—I have no doubt she is, but that is the nation that will not persist. There is no doubt about that.

"Now, there are so many points that we could discuss, and there is no doubt gentlemen, of the fact that a man becomes extremely expert in a certain procedure, and I, personally, love to see him do it; but when you are teaching a large number of students year after year, I think the older you grow the more hesitant you become in teaching to that young man anything that is very delicate or complicated. You are perfectly willing to teach it to him, but in postgraduate courses. We are attempting, I think, and will succeed in enforcing a hospital year for every man; that is, every man, before getting a license to practice, must serve as an intern for one year. If we can get that, we have got something important that we might add to our undergraduate training, but, in addition, I would like the men to come back, as they do to your Lying-In and to your other hospitals, and then train them as far as you like.

"I do not want to seem to be opposed to operative procedures. That is not the impression I wish to convey. I only would like to be regarded as the sort of man that if the labor can terminate spontaneously then it is better to let the patient do so. In a complication, a good man foresees it quickly, or sees it quickly, and acts promptly, of course. I want to see men sufficiently trained to meet such emergencies."

FUNCTIONAL DYSTOCIA IN NORMAL PELVES: RECOGNITION AND MANAGEMENT*

BY

JAMES A. HARRAR, M. D., F. A. C. S.
Attending Surgeon

THE recognition and management of functional dystocia may seem a superflous thesis in these days of short cuts and time-saving obstetrics, but it becomes necessary sometimes to recite one's obstetrical creed just to be sure where one is. In obstetrics as in other branches of surgery there is usually more than one way to achieve a result, and one cannot be too dogmatic in insisting this method is always wrong and that one always right. In this discussion I shall present my personal preferences in treatment but I believe I am speaking for the majority of the staff at the New York Lying-In Hospital. Most of us have worked together so long that given an obstetrical situation the essentials in the management proposed would agree practically 100 per cent.

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At the Lying-In, with its large indoor ward service and outdoor tenement service, it has been considered advisable to try out new procedures as they have arisen, limited only by the determination of making and keeping the hospital regarded as the safest place to have a baby. I believe we have extracted the beneficial elements from the employment of the Freiburg Dammerschlaf, pituitrin, rectal examination, the low two-flap cesarean, median episiotomy and elective version, without completely adopting any of them. All in all, guided by the successive hospital heads, the tendency has been to cling to the old doctrines and straight obstetrics. I might say we have not so much adopted this course as stuck to it.

When to Interfere

I chiefly desire to indicate the routine of procedure in handling tedious labors in normal pelves, that being employed year in and year out has given us the best results.

As it is impossible to define prolonged labor in an individual confinement in units of time it were better to pronounce a labor prolonged or delayed:

1. When there is primary inertia with ruptured membranes.
2. When despite good contractions there is no advance in cervical dilatation or in progress of the presenting part.
3. When there is advance, with increasing malposition.
4. When, due to the above causes, increasing tonic spasm of the uterus develops with continued ascent of Bandl's contraction ring.
5. Lastly and most definitely when the mother or child is showing signs of exhaustion.

Early recognition of organic abnormalities is not so difficult. With careful antepartum examination we can determine rather accurately the size of the bony pelvis, to a certain extent the size of the fetal head, and experience gives us a fair idea of the accommodation of a given head to a given pelvis. The compressibility of the particular head during labor, however, is something we cannot foretell. It is the functional abnormalities of dilatation, propulsion, high retraction of Bandl's ring, plasticity of the fetal head, tolerance of the child to pressure both of head and placental circulation, and increasing malposition that makes such cases as I am discussing so treacherous. These abnormalities are ones that only can be appreciated as they develop during labor.

It is good practice for the nurse or attendant to count and record the fetal heart very frequently during active labor, the same as we learned it important to do in our study of scopolamin amnesia. This gives us a valuable chart of the baby's endurance. The first signs of distress on the part of the baby are disclosed by irregularities in the rate and rhythm of the fetal heart and usually before the passage of meconium is observed. Much overlapping of the cranial bones and the development of a very tense caput are also important evidence that the child is being subjected to dangerous pressure.

If labor is delayed, a sufficient number of vaginal examinations must be made to properly supplement the abdominal findings. If there is any question of cesarean section, examination to determine progress may be made by rectum. We prefer, however, routine pelvic examinations to be made vaginally, but limit them to the fewest number possible. The hospital morbidity records are very satisfactory to us in a long series of cases handled with vaginal examinations both indoor and outdoor. Our figures for the past year are 7 per cent morbidity in the wards and 5.7 per cent in the tenement service. The outdoor mortality in 1921 was one maternal death in eighteen hundred confinements, including all cases transferred into the hospital for delivery. We believe the routine vaginal examinations even made as they are by many students and internes, but with proper asepsis of hands and vulva, have been of greater teaching value than those made by rectum. An inexperienced student or interne can do considerable damage to the rectal mucosa. A rectal examination cannot disclose the hot, dry, swollen vagina of prolonged neglected labor, nor can it give a sufficient mental picture of the form or size of the pelvis of the woman perhaps first seen when in labor by the student, interne or consultant. The attendant must know accurately what is going on, and it is only by thorough familiarity with the normal mechanism that he may realize when things are not progressing as they should. The good old mechanism of labor, the stumbling block alike of the professor trying to teach it an of the student trying to understand it, must still hold our constant bedside attention at every case. In case the slightest doubt remains as to the position of the head or the capacity of the pelvis, the patient should be put under an anesthetic and a thorough examination made. There are two main problems in prolonged labor: one of dilatation, and one of propulsion, and the solving of these still depends upon the understanding and regulation of the relation of the forces, the passages and the passenger.

How to Interfere

If there are hard pains, with rigid cervix in the first stage, the use of morphine-scopolamin is frequently efficacious in controlling the mother's sufferings and preventing her nervous exhaustion while the cervix dilates. A constant observation in the twilight sleep use of scopolamin was the apparent minimum of uterine effort required in effecting smooth and rapid dilatation of the cervix. With membranes intact and dilatation slow, an additional freeing of the membranes for a couple of inches around the os keeps the case under our control much better than their rupture, and should first be given a trial, though in multiparae simple rupture at three to four fingers, with a cervix well effaced, will often be productive of a prompt delivery. As may be observed at cesarean section the membranes are chiefly adherent around the lower uterine zone and the more markedly so the less the cervical dilatation. It has also been recognized by other observers that the physiologic adhesion of the membranes about the cervix when marked does interfere with the mechanism of retraction. When sufficient retraction has resulted in effacement but with dilatation still incomplete and the labor becomes prolonged, insertion of a bag is a most valuable manoeuver to prepare the case for delivery. When we have primary inertia with ruptured membranes and cervix only one or two fingers and not effaced, packing of the cervix and upper vagina with gauze is usually of greater value in softening up the cervix and starting good pains than the bag. In this situation the bag does not always work so well. That there are certain limitations in the action of the bags we are forced to admit. Thus there are instances when by intermittent traction on the bag it is finally pulled through without any uterine contractions intervening. In others the presence of the bag excites pains, but as soon as it is pushed through, labor comes to a standstill. A larger bag does the same thing, and a long four to five finger cervix is left on our hands and the baby still undelivered. It is still too early for forceps and breech extraction after version through such a cervix is exceptionally hazardous even after manual dilatation.

Manual dilatation is only safely effected in a cervix that is pretty well effaced. Even then, except when only a remaining rim needs to be reamed out, there is danger of tearing and hemorrhage. Incidentally, before doing a version one of the most comforting methods I know in surely ascertaining that the cervix is completely dilated flush with the vaginal wall, especially if one's hand is not larger than a seven and a half glove, is to pass an easily sterilized object, such as a china nest egg, in advance of the hand. Then by grasping the egg, the fist can be made as large as is necessary to make it snugly fit the birth canal. As it is slowly withdrawn the resistance of any remaining rim of cervix can be sufficiently abolished to secure the ready passage through it of the aftercoming head.

If delivery is imperative, and the cervix is effaced and three to four fingers dilated but still too rigid to dilate manually without tearing, small snips with scissors on either side after the fashion of Dührssen's lateral incisions are of great value before forceps, and are especially to be thought of when the aftercoming head catches in the cervix. If any extensive enlargement is required or the cervix is not well drawn up, the anterior and posterior vaginal cesarean incisions are safest as further incising is better under the operator's control. In all incisions of the cervix it is well to remember that there is of course a lack of dilatation of the tissues between the incisions, and they are only to be used in definite emergency.

When dilatation of the lower soft tissue funnel, the levator ani margin and the urogenital septum becomes necessary, we are inclined to prefer manual dilatation with plenty of lubricant and repair of such small lacerations as may be superimposed, restricting episiotomy to the cases when danger of a tear into the rectal sphincter is imminent, or when the baby is doing badly and must be instantly delivered. It is a matter of comment in the wards that there is more fever after the repair of episiotomy wounds than those of spontaneous laceration. Whether this is due to house surgeon's technic or to the opening up of less protected planes of tissue to absorption is subject to question.

Coming now to the delivery of the baby in prolonged labor. Close examination for anomalies of the baby's size, attitude and position will sometimes reveal the cause of the delay. Oversize, total or in part, such as hydrocephalus or abdominal ascites; attitudes of deflexion, especially brow, and failure of rotation in posterior position are to be carefully ascertained before attempting delivery. The use of pituitrin by the resident staff is not permitted before the birth of the baby, and is very rarely so employed by any of the attending staff. It is used rather frequently for postpartum bleeding before the full effect of ergot can take place.

With the head at or above the brim we have always favored version in preference to high forceps and still do. The case histories present 3298 versions as opposed to 814 high forceps, or in the ratio of four to one. Potter of Buffalo had laid emphasis on the combined avdantages of a certain group of manoeuvers in podalic version and breech extraction. The details are not new, but the combination results in such an excellent delivery as to give the name "Potter Version" to the operation. We are endeavoring to adopt this grouping of manoeuvers when we have to do a version and most of us find each step the easier done in the way Potter practices. Even with improved results, however we still adhere to the old indications, and if we are doing a few more versions it is only because we are doing less high and hard median forceps. Version competes with high and hard median forceps, but we are not yet prepared to admit that it competes with low median forceps or in any way with undelayed spontaneous delivery.

Just here to reiterate for emphasis in breech extraction, one should always be prepared to make use of Dührssen's incisions should the head stick in the cervix, and to use forceps on the aftercoming head, also that Potter's practice of deep digital pressure exerted externally just back of the pubic bone is the most advantageous method of applying force to the aftercoming head. Some operators are too prone to forget everything in the excitement of the moment but continual violent traction on the body of the baby.

The most frequent and most commonly unrecognized cause of delayed labor in normal pelves is failure of rotation with persistenly posterior position of the occiput. Most occiputs rotate and deliver without giving trouble, only a few become persistent.

In 8360 recognized posterior occiputs in the Lying-In Hospital, previous to 1907, only 433 or 5 per cent required interference with artificial delivery.

To return to indications for interference, briefly, it is proper to interfere in delay due to a posterior occiput, (1) when despite good contractions there is no advance, or (2) when with advancement there is an increasing extension of the head.

Version with head above midpelvis in such conditions, manual rotation and forceps extraction with the head below midpelvis are the operations of choice. Molding of the head through the brim is no contraindication to version if under complete anesthesia the uterus relaxes with sufficient elasticity to readily admit the passage of the hand and wrist through the retraction ring. In fact a well molded head is much easier to deliver in the breech extraction after version than one that has not molded.

Complete Scanzoni rotation of the posterior occiput with the forceps is a dangerous procedure in most hands. If there is but slight resistance the manoeuver is satisfactory and is a beautiful operation. But if at all difficult the leverage is so powerful that the anterior blade frequently cuts into the child's scalp and cheek just in front of the anterior ear and there is risk of high and deep vaginal tears. Under complete anesthesia manual rotation with external assistance is much to be preferred and is usually successful. I have yet to find a head that could not be rotated manually at least to the transverse position, and then by introducing the posterior blade first, the head can be pretty well held from sinking back into its former position while the other blade is applied and locked. Completing the rotation with the blades through one-eighth of a circle is simple and comparatively harmless.

I will not enlarge upon the subject of cesarean section in normal pelves, but there is undoubtedly a definite field here for the operation in oversized babies, in prolapsed cord with long poorly dilated cervix, in nonengagement with tonic uterus and live baby, and in cases of previous stillbirth from dystocia in what had been considered a normal baby and pelvis relationship.

Patience in obstetrics is next to asepsis, but it must be the active patience of close observation; not the passive patience of ignorance, allowing the mother to become totally exhausted or the baby in imminent peril of death before determining on a line of action. In prolonged labor, as thus defined, I believe any operative procedure is justified that will not injure the woman's health or harm the child.

FIBROID TUMORS COMPLICATING PREGNANCY AND THEIR TREATMENT*

BY

GEO. W. KOSMAK, M.D., F.A.C.S.
Attending Surgeon

I AM tempted to present my subject to this Society not because I have anything new to offer, but simply to reiterate by a word of caution the need of closer attention to pregnancy associated with fibroid tumors of the uterus. The great variation in the distribution of these tumors, their behavior during pregnancy, the differences in their histologic character and their clinical features before, during, and after labor, have combined to contribute to medical literature a great variety of personal opinions as to the course to be followed. On the one hand we find extreme conservatism combined with a desire to leave the case to Nature's ministrations. On the other, but much less frequently, we meet with a radical trend of thought which advocates removal of the tumor or of the pregnant uterus as the only salvation. Between these two extremes are other views couched in more moderate language. Personally, I must confess a fear in the presence of this condition that has not been alleviated by a considerable experience. I am frank to confess that the presence of a fibroid tumor associated with pregnancy fills me with doubt and uncertainty until a period of at least three or four months has elapsed after delivery. While it is true that Nature is able in many cases to handle the complication satisfactorily, both from the mechanical or physiologic and histologic standpoint, the uncertainty which attaches to each particular case calls for very careful supervision and a readiness to interfere when the occasion arises.

We may divide fibroids associated with pregnancy into two general classes. In the first, the tumor is myomatous or fibromyomatous, situated in the wall of the uterus and participating in its development with the muscle cells of that organ. No involvment of the endometrical lining need occur in such cases and the presence of the growth in the uterus may merely constitute an obstruction to labor, which is often overcome by the natural forces. In the second group of cases the tumor invades the edometrium with the production of irregular bleeding, or its orderly growth indicates exacerbation with the production of a marked hyperemia in the tumor itself, accompanied by pain; or degeneration takes place in its substance with the production of a possible sepsis, either during

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pregnancy or after labor. Although such a theoretical classification is possible, the clinical diagnosis is often surrounded with difficulties and an apparently harmless growth during pregnancy may suddenly take on characteristics that endanger the life of the patient. For this reason all such women should be kept under most careful observation during pregnancy, and the occurrence of either pain or hemorrhage should at once call for rest in bed and if possible, sojourn for further observation in a hospital.

Authorities vary as to the pathologic processes which take place in these growths in so far as actual degeneration is concerned, but enough case reports are now on hand with careful histologic examinations, so that we must accept the process of necrosis of fibroids during pregnancy as a possibility. If we can make a diagnosis of degeneration a waiting course is surrounded with danger because of the complications arising from a possible intraperitoneal rupture, or an extension of the infection to other places.

It is generally accepted that delivery by the normal forces will occur in the majority of cases and statistics seem to bear out this assumption. Apparently it is only the exceptional instances in which rapid growth of the tumor with possible degeneration, pain, or bleeding calls for operative interference. Most women with uterine fibroids are said to go through pregnancy without symptoms. Yet from personal observation and experience I feel that interference should not be delayed if pain, bleeding, or fever—either alone or together, develop at any period of pregnancy and do not subside readily and promptly with rest in bed.

In 1911 R. W. Lobenstine reported a series of 100 cases of fibroid tumors in pregnancy from the Lying-In Hospital service and of these 85 went to term, but 21 required operative delivery. Eliminating 10 low and median forceps deliveries, this left 3 versions, 2 high forceps, 4 cesarean sections and 2 Porro operations. Myomectomy was only done twice in the series; once in a primipara at the fifth month who aborted the next day, and another, also a primipara, at the third month, who delivered herself spontaneously at term. Suppuration in fibroid tumors was diagnosed in 6 cases postpartum with one death, but as there were three other deaths in the series, it is probable that gangrene with extension of the sepsis took place in some if not all of the other cases. During the first four weeks after delivery a complete hysterectomy for sloughing of the myoma was done in 3 cases and vaginal myomectomy in four others; whether operation was done subsequently in the others is not stated. A maternal mortality of 4 cases in 85 in which shock and sepsis were stated to account for death in 3 and intestinal obstruction during the puerperium in the fourth must be accepted with some hesitancy as a satisfactory result.

Since the compilation of this report the writer has had a personal experience with a considerable number of cases in private and hospital practice and in view of his observations is less inclined to look with equanimity on this complication, although Pinard in 1904 stated that 64 per cent. of his cases were delivered spontaneously and Troell reports 68 per cent. F. W. Lynch in a recent text-book on pelvic neoplasms accepts these and other figures as a favorable indication for noninterference. It has seemed to me, however, that the general complacency in the presence of fibroid tumors of the uterus that are associated with pregnancy is not a favorable or safe attitude for the profession to assume. A mortality of over 4 per cent. reported by Lobenstine, and which can probably be duplicated in other series of cases, should not be accepted without comment, especially as the cause of death in each instance was due to sepsis. Myomectomy during pregnancy is usually decried, and Lynch, for example, states that "it appears to him as a surgical curiosity with rather a narrow field for the treatment of fibroids complicating pregnancy, because it is most difficult to perform successfully in the class of cases in which interference is more frequently demanded, namely, pelvic impaction; as well as the fact that subsequent adhesions are almost the rule, and there is the ever present possibility that the scar may rupture during labor in the event that the cases escapes abortion and comes to term." I fully agree with him that compelling indications are necessary, but judgment must be exercised in determining when these indications have reached the limit of tolerance on the part of the patient. It is not possible to state definitely in any one case just when interference should be practised before term. But if a tumor becomes large enough to cause pain or obstruction, or fever, or bleeding, it should be removed if enucleation is possible, or a hysterectomy should be done. If the pregnancy has advanced sufficiently far to permit of the delivery of a living child by cesarean section or otherwise, this decision should be made before term, because the nutrition of the fetus is often interfered with by placental separation in fibroid uteri. Where the growth is impacted in the pelvis a myomectomy may be difficult, but where the tumor is above the pelvic brim myomectomy can usually be done with good results and abortion avoided by thoroughly narcotizing the patient for several days after delivery.

There is another accident of likely occurrence of which an instance has come to my attention recently, to be detailed further on. I refer to rupture of the lower uterine segment where fibroids are present in this region. It is also possible that many cases of so-called spontaneous rupture of the uterus may have unrecognized fibroids as the basis for the accident.

The recital of certain typical cases of fibroids associated with pregnancy may serve to demonstrate more effectually my contentions as outlined and serve as salient factors in the conclusions which I present.

Pregnancy in a Uterus after Myomectomy with Subsequent Delivery. Mrs. R. N.—Had an abdominal myomectomy done in November, 1916. She married subsequently and her first baby was born in January, 1919, at the Lying-In Hospital with a forcepts delivery. She apparently made an uninterrupted recovery. Her menstruation was regular, moderate in amount and she became pregnant again the latter part of 1921 and went along without much difficulty except for attacks of left sided pain which were relieved by lying down. No tumor could be palpated. She was more or less asthmatic, however, all through this pregnancy and was finally delivered at the Lying-In Hospital in August without any difficulty. The placenta was not expelled three hours later and as there was more or less bleeding a manual extraction was done. It was found firmly adherent over at least one-half its area to the anterior wall of the uterus, evidently in the region of the scar. The puerperium was marked by a very slow involution of the uterus with considerable bleeding. Her asthma becoming very much worse, the patient failed to report for observation and treatment of her pelvic condition and I did not see her again until January of this year (1923), when she stated that she had menstruated at monthly intervals since the birth of the child but very much more profusely. Her last period began about January 11th and was much more abundant than usual. On the afternoon of January 18th she discharged what she described as a very large, hard, blood clot and experienced severe cramp-like pains in the uterus. When seen by me shortly afterward the patient presented a markedly exsanguinated appearance, with a weak pulse and was in the midst of an asthmatic attack. Examination showed the uterus anteverted, about the size of a three months' pregnancy and hard but with a soft cervix which was sufficiently dilated to admit one and one-half fingers. A considerable mass of broken down tissue, without odor, was removed with the finger and it is very probable that a fibroid tumor had been passed. An exploratory curettage was done the next day and the cervix found to have contracted down since the previous examination. The uterine cavity was about five inches deep and at least a tablespoonful of broken down muscle tissue was removed. The patient's blood count before operation showed 3,500,000 red cells with numerous poikilocytes, a color index of 5, hemoglobin content 35 per cent. Preparations for transfusion were made and in view of the patient's asthma, care was taken to guard against any anaphylactic shock. Both the donor and the patient were starved for six hours and about 600 c. c. of blood by the direct syringe method was given. The patient had a moderate chill that night and the following night another chill with severe dyspnea and cyanosis, a weak thready pulse and went into collapse. She recovered within an hour after thorough stimulation but had another attack about a day later, though less severe. The hemorrhage was checked. After this improvement was rapid and an examination on January 29th showed the uterus still about the size of a three months' pregnancy but quite hard, nodular, and the cervix firmly closed.

Comment. The course of this case shows that a patient with a fibroid uterus should be kept under the closest possible observation even though she has gone through an uneventful pregnancy after a previous myomectomy. The slow involution after the second pregnancy pointed undoubtedly to the presence of other fibroids that were not immediately diagnosed but would undoubtedly have been detected had subsequent examinations of the patient been made.

A similar case with a more satisfactory outcome was that of Mrs. S., a para-ii, who came to me early in her second pregnancy with a fibroid tumor distinctly palpable in the lower uterine segment anteriorly. A steady enlargement of the growth occurred until she went into labor at term, when it was at least six inches in diameter but had been displaced above the brim. Delivery by the natural forces progressed until the head reached the outlet when a low forceps operation was done. At the time of discharge from the hospital, two weeks later, the mass could be distinctly felt in the lower uterine segment but there was no bleeding. During the next two weeks there were slight occasional hemorrhages and a rather foul discharge. When seen about a month later the patient had had a severe chill and examination showed the cervix two fingers' dilated with a rounded mass occupying the lower uterine segment. The patient was kept in bed and given small doses of ergot. Within twenty-four hours strong uterine contractions expelled a tumor as large as an orange into the vagina from which it was manually removed. The patient ran a moderate fever for several days and then involution proceeded quite promptly.

The fact that pregnancy can proceed in a uterus which has been subjected to a myomectomy is well shown by the case of Mrs. N., already detailed and also by that of Mrs. R., a doctor's wife, 31 years of age, who had her first baby after a moderately hard labor, which was terminated by forceps. The child died two weeks later in coma. The puerperium was free from fever but a foul lochia persisted for three weeks and there was considerable sloughing of the perineum. During this pregnancy the patient had a great deal of pain on the left side of the uterus and an attack of influenza with pneumonia developed during the sixth month. There was marked albuminuria. When first seen by me, about ten weeks after her confinement, she presented a subinvoluted uterus with a distinctly palpable fibroid on the left side. The patient was very desirous of having a child but in view of the undoubted fibroid condition of the uterus with its accompanying symptoms, I advised against her becoming pregnant until after an exploratory reparative operation. This was done in June, 1920. The very much eroded and lacerated cervix was satisfactorily repaired with a Sturmdorf tracheloplasty and a simple Hegar perineorrhaphy was followed by laparotomy. Exploration showed the uterus enlarged to the size of a grapefruit with a soft rounded mass projecting from the fundal region and a much softened cystic mass in the region of the right cornu which extended down between the layers of the broad ligament. An hysterectomy seemed indicated but in view of the patient's age and great desire for offspring, it was deemed advisable to do a less radical operation. Both tubes were normal, likewise the ovaries. The two well marked tumors were then enucleated with considerable difficulty and the patient made a fairly rapid and satisfactory recovery from the operation. The wounds healed by primary union and a later examination showed the uterus freely movable, small, hard, and the subsequent periods although somewhat irregular were much less profuse than formerly. There was no exacerbation of the patient's nephritis as the result of this operation and when seen again in October, 1921, she was pregnant about five months. Aside from some discomfort the patient had a moderately satisfactory pregnancy and went into labor spontaneously January 30, 1922. This was terminated by an easy low forceps. Baby cried vigorously, and weighed over nine pounds. The placenta was expressed by Credê without any subsequent hemorrhages. The uterus involuted very satisfactorily and several months later was found in an anteverted position, freely movable and no evidences of any fibroid tumors present. The cervix did not show any fresh lacerations or erosions. Aside from a slight adnexal tenderness on the left side, the patient was in good condition in so far as her pelvis was concerned. The baby unfortunately died when eight weeks old from an intracranial hemorrhage that was apparently of hemophilic origin. The patient was seen again a few weeks ago and is now several months' pregnant. This case shows that even an extensive resection of the uterus with the removal of several fibroids is capable of satisfactorily undergoing the strain of pregnancy and labor.

In contrast to the conservative treatment of the cases noted is that of Mrs. B., a woman 40 years of age, with five living children, who was admitted to the Lying-In Hospital in November, 1922, with a history of irregular bleeding after a period of amenorrhea beginning in August and accompanied by pain and a marked secondary anemia. Examination showed an abdominal tumor extending above the umbilicus, irregular in outline and consistency. The upper part was soft and the patient claimed she felt life. Examination showed a rather emaciated woman, very pale, and bleeding moderately from the cervix. The case seemed to call for radical treatment and after keeping the patient in bed for over a week, an abdominal operation was undertaken. The tumor mass was found to be the size of a seven months' pregnancy, the upper portion being cystic and thinned out with a contained fetus and the pelvis filled up with numerous hard, fibroid masses. A complete hysterectomy was done, which was rendered difficult by the many and large veins in the broad ligaments which gave rise to considerable hemorrhage. The patient made a fairly good recovery and the wound healed by primary union but during the course of the second week she developed a thrombosis in the right leg and a few days later well marked evidences of an infarct pneumonia. From all of this she recovered and when discharged about a month later had improved greatly although she still had some trouble in manipulating her right leg. In this case the woman's age and the situation of the pregnant portion of the uterus above the fibroid mass precluded any palliative operation. Constant bleeding for several months had produced such a marked secondary anemia that no other course could be considered.

That pregnancy may continue to term without interruption after the intra partum myomectomy is well shown by two cases that I have already reported in a previous communication (*New York State Medical Journal*, August, 1922). The first of these was Mrs. E., a para-i, admitted to the Lying-In Hospital in August, 1915, seven months pregnant and complaining of marked pain and tenderness in the left side of the abdomen which had been present for several weeks. At various times slight vaginal bleeding was noticed and moderate elevation of temperature was present and the patient seemed very uncomfortable. An exploratory laparotomy was done, based on the probable diagnosis of fibroid tumor with possible degeneration. The round vascular tumor in the region of the left cornu was readily shelled out, it being of the subperitoneal type and the endometrium not being involved. Prompt and satisfactory union occurred and the patient went to term and was subsequently delivered elsewhere without difficulty.

The second case, a Mrs. W., was admitted to the Lying-In Hospital with a history of a five months' pregnancy. She complained of severe abdominal pains and the examination showed an irregularly enlarged uterus with a tense bulging mass in the cul-de-sac; a moderate elevation of temperature and leucocytosis was present. Exploratory laparotomy based on the probable diagnosis of fibroids complicating pregnancy showed the uterus enlarged to the size of six and one-half months. On the left side anterior to the broad ligament was a firm ovoid tumor attached by a broad base to the uterine wall, the central portion of which was soft and apparently ready to break through the serous covering. This was excised and another tumor as large as the closed fist was found firmly impacted in the pelvic brim. The uterus was entirely delivered out of the abdominal cavity and the tumor excised with difficulty. Another smaller tumor was removed from the anterior surface of the uterus after which the organ was replaced in the abdomen. Notwithstanding the handling to which the uterus had to be subjected, it was not thought advisable to do a hysterectomy, for even if abortion occurred, the patient would still have her uterus for another perhaps more successful gestation later on. The patient made an excellent recovery and went into labor spontaneously at term, delivering herself without any assistance. The uterus involuted satisfactorily and the patient was seen within a few months and found to be in excellent condition,—the uterus small and not showing evidences of further fibroid growth. The report of the specimens removed showed necrosis of the central portions of all the tumors and had this patient been allowed to go on she would undoubtedly have developed a serious intra-abdominal condition.

These cases are each examples of the various types of fibroid tumors complicating pregnancy that are commonly met with.

Since the publication of Lobenstine's figures I have gone over another series of histories from the service of the New York Lying-In Hospital in which there were records of 114 cases with fibroid tumors of sufficient size to be noteworthy. These are the histories of 33269 confinements including abortions and postpartum cases of less than ten days, admitted to the In-Door Service from January 1, 1912, to January 1, 1923. In some of these cases the diagnosis of fibroid was not made until after delivery and constituted no obstruction or interference with labor.

My study of these cases is more or less superficial but I shall subject them to closer scrutiny at a later period. The proportion of fibroids complicating pregnancy noted in the period of eleven years is approximately 0.034 per cent. I was rather surprised to find that the total number of cases with this complication that were entered during the last two years amounted to 38; whereas in the previous eight years there were only 76. Whether this was due to the increased service, or whether more cases of this kind were referred to us, I am not yet prepared to say. Out of the total number there were 51 cases that delivered themselves without operative interference and in the remainder 63 forceps operations were done 13 times (including one high forceps), and version seven times. There were 21 cases in which cesarean section was done, including four of the number that presented contracted pelves. The operation was combined with myomectomy in nine instances and a complete hysterectomy was done in one. In this series of cesarean sections there was one death from postoperative pneumonia. There were two vaginal cesarean sections done with myomectomy, of which one recovered and the other died from shock. Abdominal hysterectomy after labor was done in two cases, and during pregnancy in one. Craniotomy was done twice, in both instances on the after-coming head after version with breech extraction. Induction of abortion was done in two cases, once with a myomectomy. There is also a record of a manual dilatation with version and breech extraction with death of the mother, and another death resulted in a spontaneous delivery from cerebral hemorrhage. This gives us a total of four deaths of mothers which may be attributed to operation.

Certain other facts elicited in this series are of interest. Placenta previa associated with a fibroid uterus was noted in five cases and manual extraction of the placenta was done 11 times. Fever, or a temperature above 100.4 for over twenty-four hours, was present in 21 cases. The condition was associated with toxemia in four instances, one of which was an eclamptic. Displacement of the fetal parts was noted in 17 cases, including three prolapsed cords. There were three instances of twin pregnancy in the series, in one of which delivery was done by cesarean section. Syphilis was diagnosed in four cases. Regarding the babies it is to be noted that there were 23 cases of premature delivery and 15 stillbirths. Abortion (from three to five months) occurred in 11 cases.

It must be admitted that the figures quoted are rather disquieting and are not quite as favorable as those from other clinics in which similar cases were studied.

Guggisberg (*Necrosis of Myomas during Pregnancy, Schweiz. med. Wochenschr., April* 28, 1921, 51, No. 17) reported a series of 16 cases occurring in his clinic during a period of eight years from 1912-1920 in which operative interference was found necessary and a total hysterectomy done without a death. In seven necrosis was present.

Heimann (*Monatschr. f. Geb. u. Gyn., May,* 1921) reporting in a clinical article, the myoma cases from Küster's clinic in Breslau during recent years, found a total of 12 cases in which the myoma was of noteworthy size. Abdominal enucleation for symptoms was done six times with four resulting abortions. The expectant treatment was followed in the remaining six cases and four delivered spontaneously. There was no maternal or fetal mortality in this group.

Attention must be called to the fact, however, that many of these women were referred to the Lying-In Hospital by outside physicians because the fibroids were the cause of a dystocia, and undoubtedly the growth of the service in this particular hospital contributed to the increased number.

Conclusions

(1) The presence of uterine myoma and fibromyoma during pregnancy calls for the most careful observation for evidence of local necrosis and if this is diagnosed by the presence of fever and an increased white-cell count, operation should be considered—either a myomectomy or hysterectomy. (2) Where a tumor is situated in the lower uterine segment and may possibly interfere with delivery, operative interference should be considered if the tumor fails to rise out of the pelvis during the last two weeks before labor, or in the early stages of this process. (3) Exploratory operation is always possible and myomectomy with satisfactory suture of the wound in the uterus may be done without producing abortion if the patient is deeply anesthetised and kept under narcotics for several days after delivery. Even if abortion occurs, the uterus is always left for a possible future pregnancy. (4) If a uterine myoma or fibromyoma undergoes degeneration during the puerperium as evidence by pain, fever, continuous lochia, either bright or foul, and possibly evidences of peritonitis, an exploratory operation should not long be delayed. It may be possible to enucleate the tumor through the vagina if it presents in the lower uterine segment, or it shows evidences of spontaneous expulsion this process may be hastened by the administration of ergot at regular intervals. (5) Myomectomy may be undertaken after

the birth of one or more children without fear of rupture of the scar in a subsequent pregnancy, provided infection of the scar does not take place.

6. The induction of abortion during the early months of pregnancy should not be regarded with favor, as infection or trauma may damage the tumor tissue to such a degree that convalescence may be markedly protracted and disturbed. It might be better to await the growth of the fetus to viable proportions if no complicating factors appear and then do a cesarean section with or without hysterectomy, or else do a total ablation of the uterus in the early months when symptoms demand the same.

HEMORRHAGES IN THE NEWBORN*

BY

LUCIUS A. WING, M. D.
Attending Surgeon

WITHIN the past decade, the closer study and observation of the newborn infant has revealed a greater incidence of abnormal conditions than was formerly recorded. Aside from anomalies of development, these conditions are chiefly traumatic in origin, and their subsequent course is dependent upon the degree and character of the injury, upon the vitality and adaptability of the individual infant, and upon early recognition and treatment in certain cases.

Of conditions affecting the newborn intracranial lesions associated with hemorrhage are of great importance, not only because of their frequency and high mortality, but on account of the permanent damage which results in many of the survivors.

Kearney, in a recent report of the examination in New York of 480 children with cerebral spastic paralysis, with or without mental deficiency, states that intracranial hemorrhage at birth is responsible, pathologically, for 70 per cent of the spastic type of paralysis in children, and for 20 per cent of the idiocy and feeblemindedness now existing.

He observes that, with a knowledge of these statistics, it is a prime consideration in present day obstetrics that every means be employed to minimize the chance of injury to the infant's cranium and its contents.

As has been ably pointed out by Ehrenfest, the frequency of fatal intracranial lesions is far greater than even recent infant mortality records would indicate. Many infant deaths, ascribed to asphyxia, are in reality due to intracranial or other injuries, the exact character of which can only be determined by a properly performed autopsy. It should be emphasized that fatal intracranial hemorrhage may occur in an infant born spontaneously, in what is considered a normal labor.

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According to time of onset, hemorrhages in the newborn may be divided into two main groups: first, those occurring during or immediately after birth; and secondly, those occurring or manifesting symptoms after a period of some hours or days.

1. We may first consider the cases of intracranial trauma with gross hemorrhage.

Various observers report more or less extensive subdural intracranial hemorrhage in from one-third to one-half of the autopsies upon stillborn infants, and in those dying in the first few days of life. In addition to hemorrhage, other traumatic effects are frequently present in cases of this type.

In 59 fatal cases of intracranial hemorrhage, 20 of which were breech and 39 vertex cases, Browne observed tearing of the tentorium cerebelli in 37 per cent, 63 per cent of which were in breech deliveries.

Losee has tabulated the location and extent of the hemorrhage found at autopsy at the New York Lying-In, in a recent series of 69 cases of intracranial hemorrhage, as follows:

Over both hemispheres	10 cases
Over one hemisphere, and beneath the tentorium	12 cases
Bilateral and beneath the tentorium	16 cases
Bilateral, beneath the tentorium, and in the ventricles	23 cases
Beneath the tentoriums and in the ventricles	7 cases
Epidural	1 case

The same observer, in autopsies over a period of ten years at the Lying-In Hospital, has observed fatal intracranial hemorrhage twice as frequently in breech extractions as in forceps operations.

Intracranial hemorrhage, occurring during and immediately after birth, may be due to the direct tearing of blood vessels in various regions, or to the rupture of thin-walled vessels by increased pressure from within.

Death, if it ensues, is due to compression of the medulla through general increase in intracranial pressure, or to more localized pressure, if the hemorrhage is beneath the tentorium.

Nature has admirably protected the infant's delicate cranial contents from the traumatic effects of the forces of labor, provided the normal vertex mechanism prevails, and there is no disproportion.

With proper engagement and progress of the head, the forcible contractions and thrust of the uterus are balanced, so far as the infant's head is concerned, by the firm support of the birth passages.

By virtue of this support of the maternal tissues, increased intracranial pressure and disruptive intracranial effects are minimized, as the cranial contents are largely fluid and noncompressible.

It follows, as a matter of mechanics, supported by clinical observation, that more intracranial injury may result in a few moments during a hasty or unskillful forceps operation, or similar attempt to extract an aftercoming head, than may result from some hours of strenuous labor with normal vertex engagement.

The hemorrhage following difficulty in the extraction of the aftercoming head is usually in a dangerous location, being most frequently found beneath the tentorium, or in the region of the medulla, and often associated with tears of the tentorium.

Babies with subtentorial hemorrhages are frequently stillborn. If respiration can be established, the infant may survive, but death in from a few hours to several days is most often observed. The clinical appearance of these infants is most typical; they are limp, have a squeaky, high-pitched cry, the respiration is irregular, and they often show alternating periods of pallor and cyanosis.

Intracranial hemorrhage following vertex cases is more often observed over the cortex, due to rupture of the cortical veins; the prognosis in these cases is usually better. In the more severe types, however, the hemorrhage is often bilateral, within the ventricles, and more or less diffuse within the cranial cavity, and the course is similar to the preceding subtentorial type, through compression of the medulla.

It is not within the scope of this paper to discuss in detail the diagnosis, prognosis or treatment of these severe types of intracranial trauma. In general it may be stated that in the more extensive lesions, the infant is either stillborn or dies shortly after birth.

Intracranial lesions of greater or lesser degree, may be suspected in all babies showing asphyxia at birth, in whom resuscitation is difficult, or when prolonged efforts are necessary to establish respiration, and particularly when the latter shows irregularities after establishment.

It may be emphasized at this point, that only the gentlest manipulations are permissible in attempting to establish respiration.

The prognosis, both as to life and future health, in babies with intracranial trauma, depends on the anatomic location and the extent of the ensuing hemorrhage.

The treatment of these infants may be considered in the prophylactic sense, by avoidance where possible of sudden or severe pressure on the child's head through any agency or procedure.

Surgical treatment by decompression, relief of intracranial hypertension by lumbar puncture, and the administration of blood or serum where hemorrhagic tendency exists, are modes of treatment applicable to suitable cases.

2. Asphyxia, without gross intracranial hemorrhage, is recorded by various observers, in about one-half of the stillborn. In this group of infants, Losee and others have observed quite constantly the

presence of capillary hemorrhages in various localities, chiefly over the cerebral cortex, the epicardium, the capsule of the liver, the pleura, the retina and beneath the conjunctiva. Many babies survive and do well, who have shown at birth marked asphyxiation with delayed establishment of respiration, and it may be presumed that capillary hemorrhages occur in many of the survivors.

Should these infants develop an early blood instability, it is probable that fresh bleeding occurs in some areas where capillary hemorrhage has previously taken place.

Although it has not been demonstrated that asphyxia alone has a marked influence on the development of hemorrhagic tendency, yet it would seem wise to regard infants in this group as potential bleeders, and to keep them under very close observation. Frequent observations on bleeding and clotting time should be made upon infants of this type during the first week after birth.

Recently we have determined the bleeding and clotting time by the Rodda method in a series of twenty-five infants, delivered by some operative precedure after abnormal labors in which were observed disturbed fetal heart action, the passage of meconium, or other evidences of fetal distress. No infants were included in this series which showed definite intracranial injury at birth, but all showed a greater or lesser degree of asphyxia, with some delay in establishing respiration.

Bleeding and clotting time determinations were made by the Rodda method on each of the twenty-five infants on the first, third, fifth, seventh, and ninth days postpartum. At some period during the examination the coagulation time was found delayed in seven cases, it was found normal at each examination in the remaining eighteen cases. The bleeding time was found normal at each examination in twenty-four cases. In one case the bleeding time was found prolonged on the third day, but became normal again on the fifth day, and this infant presented no clinical symptons of hemorrhagic disease at any time. All the infants in this series were discharged from the hospital in good condition. It may be noted that seven of the twenty-five infants showed a transient delay in coagulation time, a higher ratio than is usually observed in normal infants.

3. Hemorrhages developing in the newborn some hours or days after birth, are usually associated with hemorrhagic diathesis.

Autopsies upon cases of this type, in which death was due to intracranial hemorrhage, will usually show hemorrhage in other parts of the body, particularly in the lungs and in various abdominal organs, especially the suprarenals.

Rodda and others have shown that the normal newborn infant, exhibits a progressive lengthening of bleeding and clotting time during the first few days after birth, reaching its maximum on the fourth to the sixth day, and returning to normal from the eighth to the tenth day postpartum.

The normal clotting mechanism of the blood is a somewhat complex phenomenon, and the etiology and pathology of hemorrhagic disease of the newborn are not definitely understood. It is a well-established clinical observation, however, that a certain number of newborn infants fail during the first few days of life to maintain a proper stability of the blood. I believe that we have evidence that parturitional trauma and exhaustion have a decided bearing upon this loss of blood stability. Losee and the writer have observed a number of these infants at the Lying-In Hospital, and have been impressed with the abruptness with which symptoms may develop in an infant whose previous condition had seemed quite good. A certain number of infants in this group are born following normal labor, a certain number are premature, but the majority, in our observations, have been babies born after long hard labors, or operative deliveries. We have come to regard all such infants as potential bleeders and to observe them very closely for the sudden development of intracranial hemorrhage. Symptoms most often develop in the third, fourth or fifth day postpartum, and in the first few hours are not always clearly indicative of an intracranial lesion.

Among the earlier symptoms observed are loss of eagerness or of ability to nurse, listlessness and pallor. A little later the cry becomes higher pitched, the infant shows some spasticity and often slight retraction of the neck. The anterior fontanelle usually shows increased tension. Nystagmus is often seen and also changes in the fundus.

Later, convulsions and respiratory symptoms develop if the hemorrhagic area increases, and death ensues through paralysis of respiration.

Delayed bleeding and clotting time will be observed in these infants, usually from the onset of clinical symptoms. In some of the infants, however, bleeding and clotting time changes did not appear until after definite clinical symptoms were present to a marked degree.

Early recognition and treatment before the more serious symptoms develop are very important in these cases, and treatment should not be delayed in cases where blood changes are indefinite by laboratory test. At the Lying-In Hospital, the subcutaneous injection of human serum, as a therapeutic measure, has proved very effective, if given early. The usual dosage is 100 c. c. in the first twenty-four hours, divided into three or four doses, injected subcutaneously in the dorsal region at intervals of four to six hours. During the second twenty-four hours, fifty to sixty c. c. of serum are given in the same way, if it seems advisable.

Whole blood may be used instead of serum with equally good result, but whole blood is not absorbed as rapidly as serum and is more prone to cause irritation at the site of injection. Outside of hospitals, the administration of whole blood is preferable, on account of simplicity of technic.

The improvement in general condition and the abatement of cerebral symptoms following the administration of serum is often very rapid and satisfactory, if the serum is given early. No typing is necessary for the subcutaneous administration of blood or serum, and we have observed no unfavorable reactions following their use.

4. A certain number of newborn infants develop hemorrhagic disease of the type which has been recognized clinically for a considerable period. These cases are characterized by the development within the first few days after birth of hemorrhages beneath the skin, bleeding from the mucous membranes, the cord and elsewhere. Intracranial bleeding may or may not occur, and these cases if untreated, die from the general loss of blood, rather than an intracranial lesion. Birth trauma and prematurity appear to have an influence upon the development of this condition. These infants show marked lengthening of the bleeding time and delayed clotting time of the blood.

In a series of 21 cases of hemorrhagic disease of the newborn observed at the Lying-In Hospital by Losee and the writer, 11 cases were operative deliveries, as follows: Six forceps applications, one breech extraction with dry labor in an elderly primipara, and four internal podalic versions and breech extractions, three for pelvic deformities and one for prolapsed cord. In several of the remaining ten cases, the mothers had long hard labors, but were delivered spontaneously. These twenty-one cases were all of the typical well pronounced type of the disease, and were treated by blood transfusion or the subcutaneous injection of human serum. One baby in the series died of cerebral hemorrhage and anemia, the others completely recovered. Twelve of these babies have been followed for a year or longer, these have developed normally and have shown no recurrence of bleeding tendency. Transfusion, with either unmodified or citrated blood, controls the bleeding tendency more rapidly than the subcutaneous injection of whole blood or serum, and restores the blood already lost by the infant but necessitates some delay for typing and preparation.

In concluding these observations on the subject of hemorrhages in the newborn, the following points may be emphasized.

1. Hemorrhages developing in the infant during birth or shortly after, are of greater frequency than was formerly believed; they often occur in babies born spontaneously.

2. Sudden or severe compression of the child's head, either by the natural forces of labor or by some obstetrical procedure, is the chief mechanical cause of intracranial lesions.

Asphyxia of the infant during birth has an influence on the stability of the blood and impairs the clotting power. This renders these infants especially susceptible to both immediate and delayed hemorrhagic lesions.

3. Theurapeutic measures, to be effective in these cases, should be employed early in their development; the attending obstetrician should thoroughly appreciate his responsibility for the early recognition of hemorrhagic conditions in the newborn.

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BACTERIAL ENDOCARDITIS COMPLICATING PREGNANCY

BY

MEYER ROSENSOHN, M. D.
Attending Surgeon

THE infrequency of the association of the conditions referred to in the title makes interesting the details of this case.

R. S. A. N. 80756 age 28; para 1, was admitted to the Lying-in Hospital on August 9th, 1922 in active labor. She gave a history of several attacks of rheumatism, the last, two and a half years ago when she was told that she had cardiac involvement. Her chief complaint during her pregnancy was shortness of breath on exertion. She was delivered by a low forceps operation of a full term living child, there being a first degree laceration which was immediately repaired.

Her temperature which was normal on admission rose to 100° on the second day, fluctuating for the first ten days with slight remissions around 101° after that with greater remissions around 103°. When first seen on August 29th, the patient showed the evidence of a decompensated double mitral lesion, tachycardia, marked anemia with pulsating jugular vessels and a liver which reached about 6 c.m. below the free border of the ribs in the mid-clavicular line. There was no spleen, nor bone tenderness; and no petechiae anywhere. A catheterized specimen of urine did not show any red blood cells. The pelvic examination showed no abnormality. The blood examination showed 3,750,000 red cells, hemoglobin 56 per cent; 10,000 white cells; polys 74 per cent. The appearance of the patient, the febrile reaction, the cardiac lesion and the negative pelvic condition rendered the diagnosis of bacterial endocarditis most likely. A blood culture taken a few days later showed the presence of a non-hemolytic streptococcus. This was verified by two subsequent cultures.

On October 2, 54 days postpartum, the patient died with evidence of gradual cardiac failure. No autopsy was obtainable.

Clinically the patient showed a progressive downward trend, the pulse for the greater part of the time being above 120. At times a few petechiae would be seen in the conjunctivae but at no time were there signs of bacterial emboli in the fingers or toes (Osler's "ephemeral nodules") nor red blood cells in the urine. The spleen could not be felt. There were only two chills during the entire course.

On September 16th, 37 days postpartum a transfusion by the "syringe" method of 300 c.c. was given because of the anemia, but this had very little effect.

PLACENTA PREVIA IN TWIN PREGNANCY

BY

MEYER ROSENSOHN, M. D.
Attending Surgeon

THE case reported is referred to briefly because of the profuse hemorrhage, the rapid and easy delivery and the subsequent normal convalescence in spite of the fact that considerable manipulation was resorted to as required by the exigencies of the occasion. Another point of interest is the fact that the patient was delivered of twins, the placenta being of the previa type in the first baby, and normally implanted in the second.

Mrs. J. H., A. N. 56545, C. N. 35056, age 37, para iii, was admitted in the evening of September 21st, 1916. The history, obtained with difficulty, was a meagre one, but the prominent feature was the bleeding which had occurred with the onset of labor that morning. She had been referred to the hospital by her physician with the diagnosis of placenta previa. Her previous labors had been normal. When seen shortly after admission, the patient presented a somewhat anemic appearance, the fundus reached about 7 c.m. below the ensiform; there was considerable staining of the vulvar pad. Vaginal examination showed a marginal placenta previa but in spite of the utmost care in the examination, a hemorrhage of such character occurred that the hand was kept in the cervix and the vagina to act as a tampon till the patient could be transferred from the crying room to the delivery chamber. A rapid version was done and a living male baby weighing 3,000 grams and measuring 51 c.m. in length was delivered; the placenta followed immediately with considerable bleeding. The enlargement of the uterus which was still apparent, indicated the presence of a second child and a rapid version and breech extraction succeeded in delivering a living male baby weighing 2480 grams and measuring 47 c.m. in length. The placenta too, situated in the fundus was rapidly extracted. In view of the relaxation of the uterine muscle and of the profuse hemorrhage which occurred within a few minutes of the termination of the delivery, the uterine cavity was packed with iodoform gauze. The patient was returned to the ward in good condition and had in spite of all manipulation to which she had been subjected no greater reaction than a temperature of 99.4° (oral) which occurred on the second day. She was discharged on the 12th day with her two babies in good condition.

RUPTURE OF THE UTERUS THROUGH THE SCAR OF A FORMER CESAREAN OPERATION*

BY

GEORGE W. KOSMAK, M. D., F. A. C. S.

THIS patient, Mrs. B., was admitted to the Hospital, October 27, 1922, in the early morning with a history of having gone into labor during the previous night (stoppage of pain after an hour). At the time of admission she was in good general condition, with a pulse of about 80, not having any pains and complaining merely of abdominal tenderness on palpation. In view of a previous cesarean section, for a generally contracted pelvis, preparations were made to repeat this operation. During the afternoon the fetal heart could not be heard but the patient claimed she felt the movements of the child. About noon a slight bloody show was observed. A personal examination an hour later showed a slight woman with good color, not complaining of anything and having a normal pulse rate. The abdomen was soft and the fetus distinctly palpable, giving the impression of being contained in a thin-walled uterus but no signs of fetal life could be elicited. The vaginal examination before operation, made for the purpose of rupturing the membranes, revealed a closed cervix and no presenting part could be felt. Nothing in the

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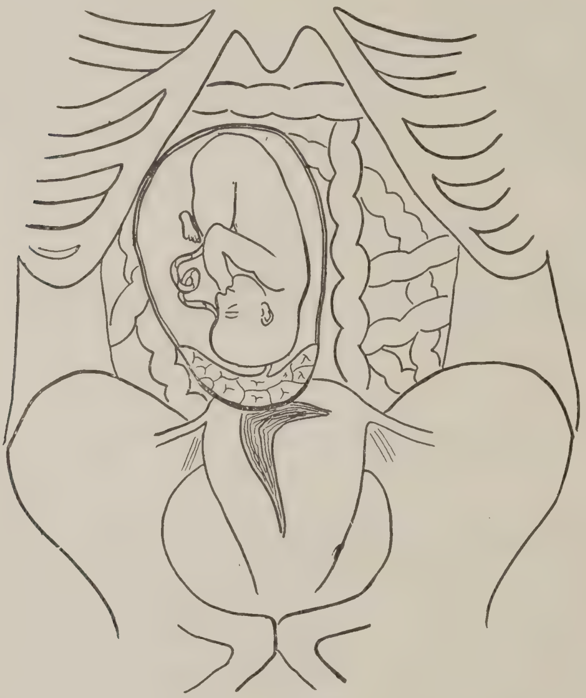
patient's condition afforded any clue to the findings at the subsequent operation.

The abdomen was incised through the former scar to the right and half above and half below the umbilicus. The abdominal wall was very thin and as the peritoneum was cut through, blood-stained fluid escaped. The incision was enlarged and a rapid survey showed an intact amniotic sac with a fetus apparently at term, which occupied the greater portion of the right half of the abdominal cavity. The placenta was at the lower pole of the sac and slightly attached to a rent in the anterior surface of the uterus. The bag of waters was ruptured and a large well developed fetus extracted which showed no signs of life. There was no maceration of the skin, no pulsations in the cord and all attempts at resuscitation were unsuccessful. The placenta and membranes were then readily removed and a further examination showed the uterus firmly contracted, well down in the pelvis with an "L" shaped rent involving the original scar and extending traversely along the fundus as shown in the diagram. (Fig. 1.) There was no bleeding from the edges of the rupture and only a small amount of free blood in the abdominal cavity.



It was not thought advisable or necessary to remove the uterus because of its firmly contracted character and the rent was accordingly sutured with interrupted plain catgut in the usual manner. There were no other points of hemorrhage. The abdomen was closed in layers.

The postoperative convalescence was uneventful and the patient was allowed to go home at the end of two weeks. A postpartum examination made on December 8th showed the uterus well involuted, anteverted, not tender and quite freely movable. The abdominal scar was firmly healed and the patient's general condition excellent.

The interest in the case resides largely in the complete absence of shock associated with the extensive rupture of the uterus and likewise the lack of hemorrhage and complete extrusion of intact amniotic sac. Instances of rupture of the scar of a previous cesarean section are unfortunately not infrequent and careful studies have been made by a number of investigators to determine the predisposing factor. Infection of the operative wound, disease of the uterine muscle, pregnancies succeeding each other rapidly, prolonged labor without relief, and a number of other causative factors have been brought forward to account for this condition. The fact that the accident occurs in the experience of almost every operator makes it incumbent to weigh the decision in every case where a cesarean operation is contemplated and to permit a thorough test of labor in each instance where no absolute dystocia exists, or where it is not necessary to resort to the operation as a life-saving procedure for the mother, such as in certain cases of placenta previa, intrauterine hemorrhage, or toxemia.

In the case under discussion the only factor which comes to mind is the short interval between the woman's two pregnancies, — only seventeen months having elapsed between the birth of her last child and the present accident.

The question of whether a sterilization of the patient was justified must be answered by the operator's own conscience. I did not consider that a uterus which was the site of an extensive rupture should be subjected to the risk of a future pregnancy in a woman of this type of intelligence. My reasons for not removing the extensively lacerated uterus were that the organ had contracted satisfactorily, there was no hemorrhage and no danger of infection of the peritoneal cavity from the rupture because the cervix was tightly closed and no vaginal examinations had been made. I considered that the continuance of menstruation was of great importance in this case, as this particular young woman would not thus be considered isolated in the ranks of her family and associates.

AN ANALYSIS OF THE MORTALITY STATISTICS OF THE LYING-IN HOSPITAL FOR 1922

BY

MEYER ROSENSOHN, M. D.
Attending Surgeon

A TOTAL of thirty-three deaths occurred in the year 1922 in 5,468 cases cared for by the Hospital, of which 3,511 were indoor, and 1,957 outdoor cases. Of these thirty-three cases seven were private patients and twenty-six were ward cases. There were five emergency cases, leaving twenty-eight deaths during the year, or excluding one general (not an obstetric case) twenty-seven obstetric deaths of patients in the hospital. Of the five emergencies two died of puerperal sepsis; one being admitted five days and the other six days postpartum. A third case was one of shock with protracted labor where a version had been done by an outside physician and the head "stuck;" the patient being admitted with the body of the child projecting from the vagina and the head undelivered. The fourth case was a patient with pneumonia and cardiac disease who died before delivery; the fifth case was a patient sent in with a rupture of the uterus. Excluding the five emergencies the remaining twenty-eight cases, or rather twenty-seven obstetric cases (the 28th being a case of hysterectomy for fibroids) the remaining cases are as follows:

5 cesarean sections. For the year there were 137 cesarean operations, therefore, a mortality of 3.65 per cent or one in 27.4 cases.

6 placenta previas. Out of a total of 26 cases, a mortality of 23 per cent, or one in 4.3 cases.

3 ruptured uteri. A mortality of 75 per cent.

4 postpartum hemorrhage.

Two cases of decompensated chronic endocarditis: One was in the hospital for 76 days and vaginal cesarean was done. A second was admitted for placenta previa; she died 9½ hours after admission of decompensated heart.

1 endocarditis, malignant.

1 necrosis of the liver with toxemia of pregnancy.

1 general sepsis following an incision of abscess in a patient three months' pregnant.

1 pyelonephritis and perinephric abscess; postpartum sepsis with B. coli and streptococcus in the blood.

1 puerperal sepsis.

1 abscess of the lung and pneumonia.

1 eclampsia.

If we analyze these twenty-seven cases further, it is fair to exclude two cases of decompensated endocarditis; the details of which are referred to above as not being real obstetric deaths. Similarly the malignant endocarditis; the case of general sepsis following incision of an abscess; and the abscess of the lung with pneumonia. There is thus left a total of twenty-two cases of obstetric deaths for the year 1922 of 5,468 cases cared for by the Hospital. This is a mortality of 0.4 per cent or one for about every 248 cases.

BULLETIN

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Bulletin of the Lying-in Hospital
of the City of New York

Vol. XIII MAY, 1924 No. 1

THE FUNDAMENTAL CAUSE OF SPLANCHNOPTOSIS—ABDOMINAL INCOMPETENCE: A DEVELOPMENTAL FACTOR.[1]

II—A Study of Certain Details of the Prenatal Evolution of the Abdomen: With Special Reference to the Status at Term.*

BY

AGNES C. VIETOR, M.D., F.A.C.S.
Boston, Massachusetts.

(Continued from Vol. XII, no. 4, page 207)

The Prenatal Proximal Colon: The Colon as a Whole: The Stomach: The Kidneys: The Uterus.

Syllabus. The Prenatal Proximal Colon:—Three classic divisions—Three subdivisions of the transverse colon—Location and course of the different portions of the proximal colon—Size: length; width—Redundancy: loops; formations—Developmentally fixed loops—Distension (dilatation?)—Longitudinal muscle bands—Sacculations—Peritoneal folds—Anatomic variations: greatest uniformity—Pathologic variations noted.

The Colon as a Whole:—Final prenatal disposition—Parietal attachment—Basic redundancy—Variable redundancy—Secondary redundancy of the ascending colon; relation to the undescended cecum—Two types of undescended cecum—Individual occurrence of redundancy: according to the predominating portions of colon affected; according to the number of portions involved—variation in redundancy of the other portions of the colon as related to the three types of sigmoid colon.—Migrations and displacements of colon loops.—Developmentally fixed loops: identification, location in the abdomen, individual occurrence.—Angulation, kinking and torsion, with special reference to mechanical obstruction and stasis; spontaneous compensation.—Anatomic points favoring mechanical obstruction and stasis.

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[1] Vietor, Agnes C.—I. Introduction to the study of the fundamental cause of splanchnoptosis—abdominal incompetence; a developmental factor. Proceedings of the Fifteenth International Medical Congress, Lisbon, April, 1906; Section IX, Chirurgie, pp. 279-304. *Boston Medical and Surgical Journal*, August 9 and 16, 1906.

*Report of Research Scholarship of the Society of the Lying-In Hospital, New York.

The Prenatal Stomach:—Shape and position.—The resting or empty stomach: the body, two variations in shape, quadrangular and pyriform; the antrum.—The distended stomach: progressive changes in shape and position of the body; changes in antrum, pylorus and 1st portion of the duodenum.

The Prenatal Kidneys:—Location.—Relative heights of lower poles of right and left.—Anatomic variations.—Pathologic variations.

The Prenatal Uterus:—Location; height of fundus.—Rotations.

THE PRENATAL PROXIMAL COLON

Three Classic Divisions: The Descending, the Transverse and the Ascending Colons

To avoid repetitions the observations of the colon which is proximal to the sigmoid colon will be grouped as far as possible under the head of The Colon as a Whole.

The proximal colon includes the classic divisions of the descending, the transverse and the ascending colons.

Three Subdivisions of the Transverse Colon

For the purposes of this study the transverse colon may be subdivided into three portions, each of these divisions being more or less associated with certain anatomic characteristics and relations.

(1) Distal, left or subgastric transverse colon—practically the portion lying to the left of the median line, and extending from the splenic flexure to the line of about the middle of the antrum of the empty stomach;

(2) Median or subcystico-duodeno-pyloric transverse colon—the portion lying in the more median part of the abdomen but mostly to the right of the median line, between the gall bladder and the pyloric portion of the antrum of the empty stomach;

(3) Proximal, right or subhepatic transverse colon—the portion lying in the right abdomen, to the right of the gall bladder and between this viscus and the upper part (third or fourth) of the right kidney.

Location and Course of the Proximal Colon. (Plates V, VI; Fig. 5)

In tracing the proximal colon one notes that its course either corresponds with the line of its parietal attachment or else it departs from this line owing to areas of colon redundancy.

The redundancy modifies the course in one of two ways: (1) the colon, with its meso, is more or less gathered or fulled-up along the line of its parietal attachment, forming ripples or coils (potential loops); or (2) the meso is more or less unfolded and the colon lies in actual U-loops of varied depth which extend vertically, horizontally or obliquely towards the centre of the abdomen.

THE DESCENDING COLON.

In 26 prenatal cases (14 at term, 12 fetal cases) the descending colon lies posteriorly in the left lateral abdomen. It sometimes approaches the sigmoid colon in size, and it is then distended with meconium. In such cases it may be visible to the extreme left of the abdominal cavity and may simulate a loop of the sigmoid colon. [This is particularly marked in 1 case at term (O-XL) but it occurs to a greater or less extent in 8 of the 14 cases at term and in 1 of the 12 fetal cases (Table X).] Sometimes it sends a redundant loop or loops medad into the left abdomen (Table VI).

Disregarding redundancy and taking the direction as a whole, the descending colon passes downward from the splenic flexure to the crest of the left ilium in a slight curve whose convexity is outward. It passes predominantly along the outer border of the left kidney but it may lie upon this latter viscus for more or less of its course (8-XLI, 7-XXIV, 5-XXIX).

THE SUBGASTRIC TRANSVERSE COLON.

The subgastric transverse colon may be considered as extending from the splenic flexure to about the middle of the antrum of the stomach. It tends to follow the greater curvature of the stomach, having a direction more or less obliquely downward and to the right from the splenic flexure.

This course is modified by several factors (which may be mentioned here but which will be discussed in more detail later), *i. e.*, by the degree of redundancy of this portion of the colon; by the depth of the transverse meso and of the gastrocolic ligament; by the degree to which these peritoneal folds are opened out; by the relative location of the splenic flexure;[22] and by the condition of the stomach as to emptiness or distension.

THE SUBSCYSTICO-DUODENO-PYLORIC TRANSVERSE COLON.

Disregarding redundancy this is the most clearly transverse portion of the transverse colon and beginning below the pyloric portion of the

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[22] In the 26 prenatal cases the splenic flexure shows some variation in location, being found anywhere from the 10th intercostal space to the 12th rib, on the posterior or postero-lateral wall. Or it may lie upon the left kidney at its junction with the adrenal (7-XXIV).

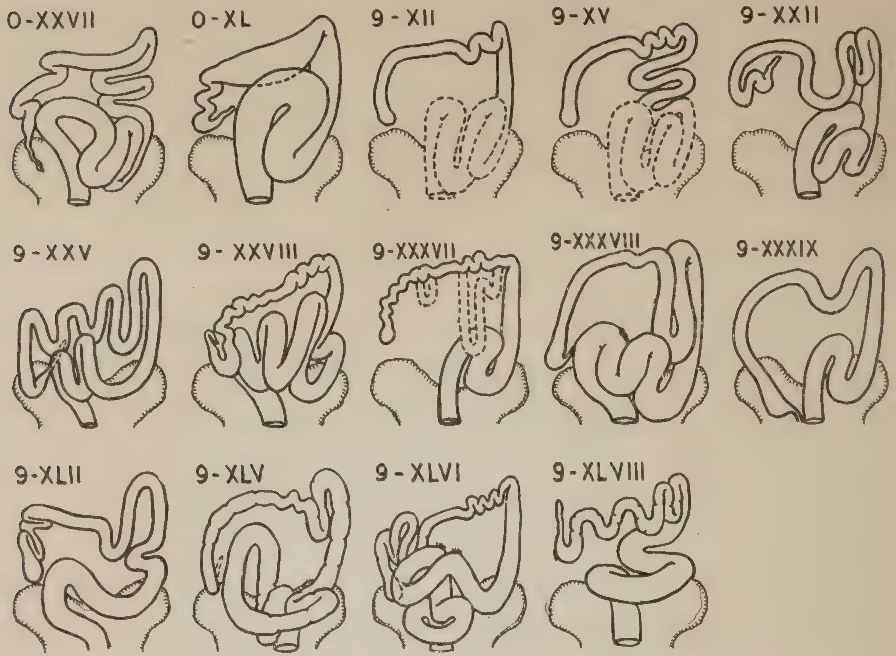

Plate V—Diagrams of the Colon, as found in 14 cases at term. (No attempt is made to indicate the larger calibre of the sigmoid or other portions except in 0-XL).

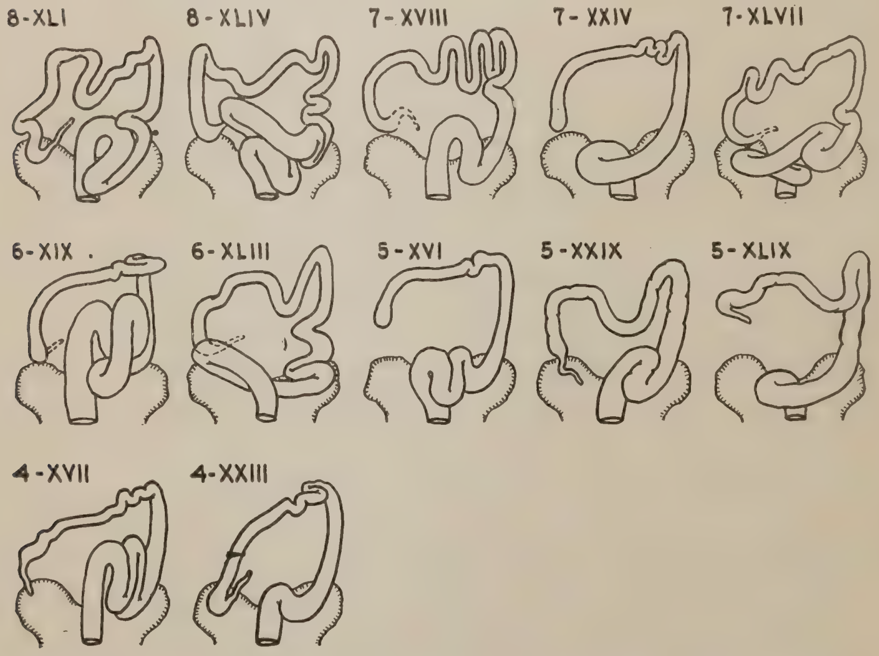

Plate VI—Diagrams of the Colon, as found in 12 fetal cases beteen the 4th and 8th months.

antrum of the stomach and passing to the right, it terminates usually at a more or less rounded angle below the gall bladder.[23]

THE SUBHEPATIC TRANSVERSE COLON.

In the 26 cases there is usually found a longer or shorter intermediate portion of colon which (disregarding redundancy) extends in a direction predominantly oblique, downward and to the right[24] between the line of the gall bladder and the upper part of the right kidney. Or in other words, between the most definitely transverse course of the transverse colon and the vertical course of the ascending colon.

This intermediate portion may be called the proximal, right or subhepatic transverse colon, and its union with the subcystico-duodeno-pyloric transverse colon is usually marked by the formation of a more or less rounded angle opening downward and perhaps inward,[24] while its

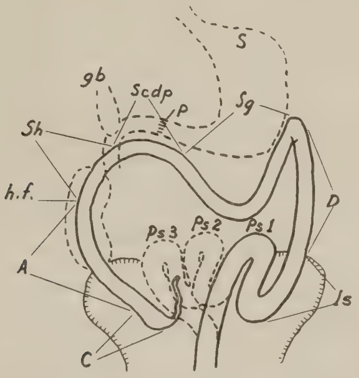

Fig. 5—Outline of Basic Redundancy of the Colon; More or less redundancy of the pelvic sigmoid and the subgastric transverse colons—*P s* 1, 2, 3, pelvic sigmoid colon of the 1st, 2nd and 3rd types; *I s* iliac sigmoid colon; *D*, descending colon; *S g*, subgastric tarnsverse colon; *S c d p* subcystico-duodeno-pyloric transverse colon; *S h*, subhepatic transverse colon; *A*, ascending colon; *C*, cecum; *S*, stomach; *p*, pylorus; *g b*, gall bladder; *h f*, hepatic flexure.

---

[23] In 5 cases (2 at term, 3 fetal cases), to the right of the gall bladder it blends indefinitely with the subhepatic transverse colon the direction of which in these cases is also transverse.

In the remaining 3 cases (1 at term, 2 fetal cases), there is no definite transverse portion, the predominant direction of the transverse colon being obliquely downward, and to the right from the splenic flexure in all three of its subdivisions.

[24] In 7, at least part of its direction is transverse, this portion of the colon blending to the left indefinitely with the subcystico-duodeno-pyloric transverse colon (in 5-XLIX while its course is transverse, the continuing part of the subcystico-duodeno-pyloric transverse colon is oblique, upward and to the left, the union producing an angle opening upward and outward).—0-XXVII, 0-XL, 9-XLII, 9-XLVIII; 8-XLI, 5-XXIX, 5-XLIX. In 2, it forms an inverted U-loop—9-XXV; 8-XLIV., In 2, it forms a right angle opening downward and inward—8-XLI, 5-XXIX. In 1, it forms an obtuse angle opening upward and outward.—6-XLIII. In 1, it forms with the ascending colon an angle opening downward and inward—9-XLVIII.

In 2 cases, there is no ascending colon, the subhepatic transverse colon being to the right continuous with the cecum—5-XLIX, 4-XVII. In 1 case, there is scarcely any ascending colon—5-XVI. In 2 cases, the subhepatic transverse colon is very short and transverse—9-XLVIII, 8-XLIV. In 1 case, there is no definite angle in the neighborhood of the gall bladder—4-XXIII.

union with the ascending colon is marked by the angle making the hepatic flexure,[25] this angle opening inward and perhaps downward.[25b]

THE ASCENDING COLON.

In 23 of the 24 differentiated[26] cases (14 out of 14 at term; 9 out of 10 fetal cases), the ascending colon[27, 29] lies upon the right kidney to a greater or less extent;[30] sometimes, it lies also upon the posterior abdominal wall to a greater or less extent before reaching the kidney.[28,30]

---

25. Hepatic Flexure—Proximal (right) end of the subhepatic transverse colon: Location: Angulation.

(a) Location. In 25 out of 26 cases (14 out of 14 at term; 11 out of 12 fetal cases) the proximal end of the subhepatic transverse colon lies on the upper part of the right kidney (in 20 of these 25 cases, this proximal end lies on the right kidney just below the upper third or fourth; in 5, it is higher up on the kidney). In the remaining 1, it lies internal to the right kidney.

(b) Angulation. In 23 of the 26 cases, the proximal, or right, end of the subhepatic transverse colon unites with the upper end of the ascending colon to form an angle, the hepatic flexure of the colon. In 1 case there is no angle, the ascending colon being located so far inward that its direction is continuous with that of this portion of the colon (4-XXIII). In the remaining 2 cases, there is no ascending colon and no angle, the subhepatic transverse colon being directly continuous with the cecum, which occupies the usual location of the upper end of the ascending colon.

In 14 of the 23 cases in which an hepatic flexure is found, the angle which it forms is obtuse, opening inward. In 5, it is about a right angle. In 1, the angle is very acute (0-XL). In 3, there is for the moment no definite angle at this point (9-XXV, 8-XLI, 5-XXIX); in these cases, the angle is potential, being removed for the moment by upward rotation of the continuing loop of the subhepatic transverse colon; when this loop rotates downward and inward, the angle becomes very acute.

26. Differentiation of the Colon into Transverse and Ascending Colons. (Fig. 3). 24 out of 26 records (14 out of 14 at term; 10 out of 12 fetal cases) show a distinct attempt at differentiation into a transverse and an ascending colon. 1 of these cases (5-XVI) appears to be just over the border line, the extent of differentiation being slight and neither mesocecum nor ascending meso being present; the cecum has descended enough to be continuous with a very short ascending colon which in turn is continuous with a typical subhepatic transverse colon.

In the remaining 2 cases, the ascending colon appears to be absent; the cecum has not descended but lies in the usual location of the upper end of the ascending colon, *i. e.*, under the liver, in the neighborhood of the upper third or fourth of the right kidney—5-XLIX, 4-XVII.

(In 1 postnatal case studied (0-VIII), a girl born at term who died at the age of 2 months, the ascending colon was absent, the cecum lay over the outer margin of the right kidney, at the junction of the upper and middle thirds, and from this point the colon passed obliquely upward and to the left to the splenic flexure. Sacculations were well marked throughout the colon.)

27. Beginning of the Ascending Colon (Cecum)—Lumbar; Lumbo-iliac; Iliac. (Fig. 3). In 15 of the 24 differentiated cases (9 out of 14 at term; 6 out of 10 fetal cases), the ascending colon begins in the lumbar region, *i. e.*, the cecum is definitely above the crest of the ilium, somewhere between "just above the crest" and "high up under the liver." In 4, (2 at term, 2 fetal cases), the cecum occupies a lumbo-iliac position, *i. e.*, it lies on the crest of the ilium but extends partly above it. In the remaining 5 cases (3 at term; 2 fetal cases), the ascending colon begins definitely in the iliac region, *i. e.*, the cecum is below the crest of the ilium, somewhere between just "below the crest" and "at the brim of the true pelvis."

Disregarding redundancy and taking the direction of its course as a whole, this is most often vertically upward (9 out of 14 at term, 7 out of 10 fetal cases): In 5, it is obliquely upward and inward (3 at term, 2 fetal cases). In 3, it is first obliquely upward and outward and then obliquely upward and inward (2 at term, 1 fetal case).

SIZE OF THE PROXIMAL COLON; LENGTH; WIDTH. (Plates V, VI.)

The length of the divisions of the proximal colon was not measured systematically but considerable variation is evident from the variation in redundancy found in each division.

THE DESCENDING COLON.

However, redundancy is not the only variable factor. For instance, in the non-redundant cases (9 out of 14 at term, 6 out of 12 fetal cases) the length of the descending colon corresponds to the distance from the splenic flexure to the crest of the ilium, but it has already been noted that the splenic flexure may vary in location, and that the left lobe of the liver

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28. Relation of the Cecum to the Right Kidney, the Abdominal Wall and the Ilium.

In 9 of the 14 cases at term and 7 of the 12 fetal cases the cecum lies in whole or in part upon the right kidney (in 9-XXVIII and 7-XLVII it lies partly on the kidney and partly on the ilium). In 5 cases (2 at term, 3 fetal cases) it lies in whole or in part upon the posterior abdominal wall (in 9-XLV and 8-XLIV also upon the crest of the ilium). In the remaining 5 cases (3 at term, 2 fetal cases) it lies in the iliac fossa (in 9-XXXIX as low as the brim of the pelvis.)

29. Distal (Upper) End of the Ascending Colon—Hepatic flexure.

In 23 of the 24 differentiated cases (14 out of 14 at term; 9 out of 10 fetal cases) there is a constant association of the upper end of the ascending colon with the upper portion of the right kidney. In the 1 remaining case, 4-XXIII, the entire ascending colon lies internal to the right kidney.

At this point in 20 of the 24 cases (13 at term; 7 fetal cases), a more or less definite angle is formed (hepatic flexure) and the colon takes thence a direction predominantly upward and to the left, forming the subhepatic transverse colon.

For details of the location and angulation of the hepatic flexure, see Proximal End of the Subhepatic Transverse Colon.[25]

30. In 16 of these 23 cases (10 at term, 6 fetal cases) it runs upward upon the right kidney. In 7 cases, (4 at term, 3 fetal cases) it lies upon the posterior abdominal wall to the outer side of the kidney (and also a little below this viscus in 8-XLI and 7-XVIII) for a greater or less distance; subsequently lying on the kidney for a longer or shorter course.

In the remaining 1 of the 24 differentiated cases, it lies in the right iliac fossa and on the posterior abdominal wall below and internal to the right kidney, not touching this latter viscus in any part of its course, (4-XXIII).

may vary in size, and something will be shown later of the variation in fractional trunk heights.[31]

THE SUBGASTRIC TRANSVERSE COLON.

This portion of the colon is found more or less redundant in all cases, both at term and in the fetal group, tending thus to be most variable in length and in this respect to resemble the sigmoid colon which is also found more or less redundant in all cases.

THE SUBCYSTICO-DUODENO-PYLORIC TRANSVERSE COLON.

In 7 out of 14 cases at term and in 6 out of 12 fetal cases, the subcystico-duodeno-pyloric transverse colon is non-redundant, corresponding in length with the distance from the midantrum to the line of the gall bladder. Even in these non-redundant cases possible sources of variations in length suggest themselves according to variations in the length of the pyloric antrum and the 1st portion of the duodenum, and in the fractional trunk breadths, as well as in the location of the gall bladder.

THE SUBHEPATIC TRANSVERSE COLON.

In 9 out of 14 cases at term and in 9 out of 12 fetal cases, the subhepatic transverse colon is non-redundant and tends to correspond in length with the distance in an oblique line from just below the gall bladder to the hepatic flexure on the upper 3rd or 4th of the right kidney. The tendency to variation in these non-redundant cases is also marked since we have to consider variation in the location of the gall bladder, in the size of the right lobe of the liver, in the height of the right kidney, in the location of the hepatic flexure, and in the fractional trunk breadths and heights.

THE ASCENDING COLON.

This portion of the colon shows considerable variation in length even in the non-redundant cases because the location of its beginning (the cecum) and of its termination (the hepatic flexure on the upper part of the right kidney) both show variation. The kidney shows some variation in height above the crest of the ilium, and the hepatic flexure shows some variation in height upon the kidney. But one may note here that of the

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[31] In 1 non-redundant case (9-XXII) the descending colon was noted as being 10 mm. in length from the splenic flexure to the crest of the ilium; in 1 redundant case having 2 loops (0-XXVII) it was noted as being 85 mm. long, the distance from the splenic flexure to the crest of the ilium being in this case 30 mm.

It is interesting to note that in both of these cases the left lobe of the liver passed under the costal margin at the level of the junction of the 8th costal cartilage with its rib, so some factor other than the size of the left lobe of the liver and the fractional trunk height must assist in determining the length of this portion of the colon.

15 non-redundant cases, in 12 the ascending colon begins in the lumbar region (5 at term; 7 fetal cases); while in the remaining 3 cases, it begins in the iliac region (2 at term; 1 fetal case). (Fig. 3). Variation in the size of the right lobe of the liver and in fractional trunk heights are factors which must also be considered.

The width of the proximal colon was not measured but in some cases it was much increased in certain portions by distension, occasionally so much so as to suggest actual dilatation. Details are noted in the chapter on Dilatation, in The Colon as a Whole.

The width of certain portions of the colon was found markedly diminished in a few cases. Details are noted in the chapter on Pathologic Variations noted, in The Colon as a Whole.

Redundancy of the Proximal Colon: Loops; Formations; Vertical, Oblique or Horizontal U-, Reversed S-, M- or W-Shaped Colon in the Left, Left and Median or Left, Median and Right Abdomen. (Plates V, VI; Table XI).

The Descending Colon.

In 5 of the 14 cases at term and in 6 of the 12 fetal cases the descending colon is redundant, leading to the formation of loops which are either present or potential.

The loops tend predominantly to be horizontal, their apices extending medad into the left or even left and median abdomen, and they may also extend downward or even forward.

1 loop is found in 3 cases at term and in 5 fetal cases, and 2 loops are found in 2 cases at term and in 1 fetal case. These loops vary in depth from 12 to 65 mm. at term and from 3 to 15 mm. in the fetal cases.

Whenever more than 1 horizontal-U loop occurs additional formations (vertical S or reversed S, or horizontal M or W) may be made.

The Subgastric Transverse Colon.

In all 14 cases at term and 12 fetal cases the transverse colon to the left of the pyloric half of the antrum is more or less redundant, leading to the formation of loops which are either present or potential.

1 loop is found or is potential in 10 of the 14 cases at term and in 10 of the 12 fetal cases. Sometimes the loop is not formed by the subgastric transverse colon alone, the subcystico-duodeno-pyloric transverse colon entering into the formation of its right portion (2 at term, 4 fetal cases).

2 loops are found in 4 cases at term and in 2 fetal cases. The 2nd or right of these loops is not always formed by the subgastric transverse colon alone; in 1 of the cases at term and in both fetal cases its right portion is made by more or less of the subcystico-duodeno-pyloric transverse colon.

TABLE XI
INDIVIDUAL OCCURRENCE OF DEVELOPMENTALLY FIXED LOOPS OF THE COLON
(EXCLUDING THE SIGMOID COLON)
Cases at Term

Case No.	Asc. Colon	Hep. Flx.	Subhep Trans.	Subcyst-duod-pyl Transverse			Subgastric Transverse			Spl. Flx.	Desc. Colon	Type of Pelv. Sig.	No. of re-dund. ptns.
				Gb.	1st duod.	Pyl.	Mid antr.	Antr-body junct.	Body of Stom.				
0-XXVII	1		2 (hor)	..			1				1	2nd	6
0-XL	2		1 (hor)	..			1				..	1st	4
9-XII	..		..	..	..	..			1		..	2nd or 3rd	2
9-XV	..		..	..	..	..			1		2	2nd	3
9-XXII	1		..	..	..	..			1 (or 2)		..	2nd	3
9-XXV	..		1	1	..		1		1		..	2nd	4
9-XXVIII	1		2 (obl)	..	1				1		1	3rd	6
9-XXXVII	2		2 (obl)	..	1				2		..	1st	5
9-XXXVIII	..		..	..	..	..			1		..	2nd	2
9-XXXIX	..		..	..	..	..			1		..	1st	2
9-XLII	1		2 (hor)	..	..	..			1		1	1st	5
9-XLV	..		..	..	..	..			1		..	3rd	2
9-XLVI	1		..	1	..	..			1		..	3rd	4
9-XLVIII	..		..	..	..	1			1 (or 2)		1	1st	4
Fetal Cases													
8-XLI	1		1	..	..	..			1		1	1st	5
8-XLIV	1		..	..	1						2	3rd	5
7-XVIII	..		..	..	1		1		1		1	1st	4
7-XXIV	..		..	..	..	..			1		..	1st	2
7-XLVII	..		..		1		1				1	3rd	4
6-XIX	..		..	..	..	..			1		..	3rd	2
6-XLIII	..		1	..	..				1		1	2nd	5
5-XVI	..		..	..	..	..			1		..	2nd	2
5-XXIX	..		1	..	..				1		..	1st	4
5-XLIX	..		..	..	..				1		1	1st	4
4-XVII	..		2 (obl)	..	..	..			1		..	2nd	3
4-XXIII	..		..	..	..	..			1		..	1st	2

The maximum depth of the loops varies from 13 to 45 mm. or more at term, and from 9 to 45 mm. in the fetal cases.

The subgastric transverse colon tends in the main to lie more or less fulled-up in small irregular coils or potential loops, following the inferior border of the left half of the antrum and the inferior border and the lower part of the external border of the body of the stomach.

But at some part of its course it tends predominantly to fall downward in one or more relatively deep U-loops or festoons, these loops tending to reach the full depth of the related portion of the transverse meso and the gastrocolic ligament. This tendency to fall in deep loops is especially marked under the influence of distension.

The shape of the loops or festoons varies from that of a part of a circle or an ellipse to a U- or a V-shape; or if more than one of the latter are present, to a W- or M-shape. Sometimes the loops can be changed into one long festoon. In such a case, the location of the unfixed secondary loops may be changed at will. In some cases the location of the secondary loops is fixed, owing to irregularity in the line of adhesion of the transverse meso and the gastrocolic ligament.

In all cases as the transverse meso and the gastrocolic ligament unfold, this portion of the colon forms at least one large, more or less fixed loop. This is due to the uniform fixation of its left extremity (splenic flexure) and to the predominantly more or less fixed position of its right extremity (below the proximal half of the antrum). This subantral fixation is due to the predominantly diminished depth of the transverse meso and the gastrocolic ligament in this region.

When unfolded the loops of the subgastric transverse colon tend predominantly to be relatively deep and to extend downward in the left or left and median abdomen.[32] Wherever else they may occur, there is a predominant tendency for one to be formed a little to the right of the splenic flexure, and frequently in the line of the vertical external border of the empty and retracted stomach. Such a loop is found in 9 of the 14 cases at term and in 7 of the 12 fetal cases; in 2 of the latter it is thrown to the left so as to lie horizontally across the splenic flexure.

THE SUBCYSTICO-DUODENO-PYLORIC TRANSVERSE COLON.

In 7 out of 14 cases at term and in 6 out of 12 fetal cases the subcystico-duodeno-pyloric transverse colon is more or less redundant in some part of its course, leading to the formation of loops which are either present or potential. At least 1 loop is found or is potential in all 13 cases. Sometimes the loop is not formed by the subcystico-duodeno-pyloric transverse colon alone, the continuing subgastric transverse colon entering into the formation of its left portion.

In no case does this portion of the colon of itself form 2 loops, but in 3 of the 13 redundant cases it enters into the formation of a 2nd loop by continuation with the adjacent redundant subgastric transverse colon.

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[32] In all of the 26 cases, a U-shaped colon into the formation of which the subgastric transverse colon enters, is found (or is for the moment potential) in the left abdomen. But if the stomach is distended, these loops may swing towards the median, or even the right, abdomen. Extension of the loop towards the median or right abdomen occurs also as the subcystico-duodeno-pyloric transverse colon enters into its formation.

In 7 of the 14 cases at term and in 7 of the 12 fetal cases, the subgastric transverse colon may enter into the formation of a more or less clearly defined or a more or less potential W-shaped colon which may extend anywhere from the left to the right abdomen. These W's are formed by 2 U's which may be directly connected or may be more or less widely separated, and either of which may be small, irregular or potential. But the W-formation seems to catch the eye and its varied composition makes its analysis of anatomic and clinical value.

The depth of the loops made by the subcystico-duodeno-pyloric transverse colon alone, varies from a few mm. up to 28 mm. at term and to 15 mm. in the fetal group. The depth of the loops formed by combination with the subgastric transverse colon varies up to 15 mm., but that of the portion which is contributed by the subcystico-duodeno-pyloric transverse colon is sometimes only a few mm.

The loops of the subcystico-duodeno-pyloric transverse colon tend to be small or of only medium depth, as compared with those of the subgastric transverse colon. They lie fulled-up below the gall bladder, the 1st portion of the duodenum or the pyloric half of the antrum; or they tend to extend downward in vertical U-loops in the right, right and median or median abdomen.[33]

The subcystico-duodeno pyloric transverse colon loops are less capable of rearrangement than are those of the subgastric transverse colon. In only 3 of the 13 redundant cases did this portion of the colon form 1 large loop embracing entirely or nearly its whole extent, and in these cases the loop was continuous with the subgastric transverse colon.

In the other 10 cases, the adhesion of the major peritoneal folds (transverse meso and gastro-duodeno-colic ligament) was such that only 1 larger or smaller loop was formed in a limited area (9-XXVIII, 9-XXXVII, 9-XLVI, 9-XLVIII), or only part of a loop was formed (6-XLIII, 5-XXIX, 5-XLIX), or else the adhesion was so irregular as to form a secondary fixation—one loop and part of a second, the remainder of the 2nd loop being formed by the subgastric transverse colon, (9-XXV, 7-XVIII, 7-XLVII).

When a loop is formed by the subcystico-duodeno-pyloric transverse colon alone and a second loop is formed by this portion of the colon in combination with the subgastric transverse colon, a W[34] or M formation may result; a W or M may also result when the second loop is formed (to the left) by the subgastric transverse colon alone or (to the right) by the subhepatic transverse colon alone.

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[33] In 6 of the 13 redundant cases (4 at term; 2 fetal cases), the subcystico-duodeno-pyloric U-loops lie in the right abdomen, and they are all formed by the subcystico-duodeno-pyloric transverse colon alone (in 9-XLVIII, the loop lies more in the right and median, or even median, abdomen, being subpyloric).

The remaining loops are formed with the aid of more or less of the subgastric transverse colon and thus tend to extend more, or also, towards the median and left abdomen.

[34] In no case observed did the subcystico-duodeno-pyloric transverse colon alone completely form 2 U's, hence no W's or M's were observed to be formed completely by the subcystico-duodeno-pyloric transverse colon alone.

But in 11 of the 26 cases, the subcystico-duodeno-pyloric transverse colon enters into the formation of a more or less clearly defined or a more or less potential W-shaped colon which may lie anywhere from the right to the left abdomen (5 at term; 6 fetal cases).

THE SUBHEPATIC TRANSVERSE COLON.

In 5 out of 14 cases at term and in 4 out of 12 fetal cases, the subhepatic transverse colon is more or less redundant, leading to the formation of loops which are either present or potential. 1 loop is found, or is potential, in 1 case at term and in 3 fetal cases; and 2 loops in 4 at term and 1 fetal case.

As both extremities of this portion of the colon are definitely more or less fixed—the left by the diminishing depth of the transverse meso and by the attachment of the cystico-colic ligament, and the right by the attachment of the hepatic flexure to the upper portion of the right kidney—its loops are all formed by the subhepatic transverse colon alone.

The depth of these loops does not extend beyond a maximum of 18 mm. at term and 12 mm. in the fetal cases.

The loops of the subhepatic transverse colon tend to be not very deep and they lie to the right of the gall bladder, under the dome of the liver. They occur fulled-up in ripples or in horizontal-U's, these latter with bases directed inward or outward; or they are unfolded and they are then thrown upward, or upward and outward, in a small vertical or oblique inverted U-loop, or they fall downward and inward in an oblique U.

When the loop falls downward, it may enter into the formation of an irregular W-shaped colon—the other U of the W being furnished by the subcystico-duodeno-pyloric or the subgastric transverse colon, or even by the ascending colon.

In no case observed did the subhepatic transverse colon alone form 2 U's with bases in the same direction, hence no W's or M's were formed by the subhepatic transverse colon alone. In the cases showing either ripples or two horizontal U's, the bases of the U's alternate in direction, thus making S-formations rather than W's or M's.

Experimentation has shown that unless fixed secondarily by irregular adhesions of the transverse meso, all loops of the subhepatic transverse colon may fall downward—like the loops of the other portions of the transverse colon. But unlike these other portions of the transverse colon, a subhepatic transverse colon loop is always formed by the subhepatic transverse colon alone, and it tends to consist of the entire length of this portion of the colon. Also, owing to its course and attachments, the loop tends to lie more or less obliquely downward and inward.[35]

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[35] In 1 non-redundant case (0-XL), in the extreme right upper abdomen, the subhepatic transverse colon after a transverse course, enters into the formation of a fixed horizontal U whose base is directed outward. This formation is made by combination of the subhepatic transverse colon with the redundant ascending colon.

In 1 non-redundant case (9-XLVIII), the very short subhepatic transverse colon in taking a transverse course, enters into the formation of an inverted-U, the rest of the formation being made by the ascending colon and the subsystico-duodeno-pyloric transverse colon.

THE ASCENDING COLON.

In 7 out of 14 cases at term and in 2 out of 10 fetal cases the ascending colon is more or less redundant, leading to the formation of loops which are either present or potential. 1 loop is found or is potential in 4 cases at term and in 2 fetal cases and 2 loops are found in 3 cases at term.

As both extremities of this portion of the colon are definitely fixed or limited—the upper by the hepatic flexure, and the lower by the cecum—its loops are all formed by the ascending colon alone.[36]

The loops of the ascending colon are all small (predominant depth noted, 10 mm.; maximum depth, 15 mm.), and they lie in the right lateral abdomen only. They occur fulled-up in ripples or in larger U-loops, which latter tend to extend vertically upward or downward; horizontally inward or outward; or obliquely downward and inward, or downward and outward, or upward and inward, or upward and outward. This portion of the colon when redundant shows a practically constant tendency to reverse its direction after a short course, producing the above variation in loops and making a vertical, oblique or horizontal S or reversed S.

Secondary adhesion of the meso may fix one or more of these loops in one of the above positions, but in the absence of such adhesion and with a sufficient depth of meso, the loops may become unfolded and fall inward and downward.

When this portion of the colon falls thus in 2 loops with their bases in the same direction, a horizontal or oblique W or M is formed by the ascending colon alone.

If only one loop unfolds and falls inward and downward this may enter into the formation of an irregular W-shaped colon—the other U of the W being furnished by the subhepatic, the subcystico-duodeno-pyloric, or even the subgastric transverse colons.

DEVELOPMENTALLY FIXED LOOPS OF THE PROXIMAL COLON
(Plates V, VI; Table XI)

Developmental fixation of loops of the proximal colon is due to redundancy of a portion of the colon combined with irregularity in the adhesion of its meso or other related normal peritoneal fold.

THE DESCENDING COLON.

In the 11 redundant cases (5 out of 14 at term, 6 out of 12 fetal cases) the descending colon forms at least 1 loop which is developmentally more or less fixed somewhere between the splenic flexure and the crest of the left ilium but at term most often at or below the lower part of the outer border of the left kidney.

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[36] In 1 case, 0-XL, in the extreme right upper abdomen the terminal limb of the fixed upper horizontal U of the ascending colon (base inward) enters into the formation of a still higher, fixed horizontal U whose base is directed outward. The more cephalad limb of this U is made by the non-redundant but fixed transverse subhepatic transverse colon.

In all cases, both redundant and non-redundant, the upper end of the descending colon was found fixed at the splenic flexure, while the lower end was found fixed at the crest of the left ilium in 7 of the 11 redundant cases and in 14 of the 16 non-redundant cases.[37]

2 fixed loops are noted in 1 case at term and 1 fetal case, and 2 may possibly be formed later in 0-XXVII and 9-XLVIII if, and as, further adhesion of the meso occurs irregularly. In 1 case at term (9-XLII) the loop is additionally fixed by a peritoneal "veil."

THE SUBGASTRIC TRANSVERSE COLON.

In all of the 26 prenatal cases the subgastric transverse colon tends to form at least 1 large more or less fixed loop. This is due to the uniform fixation of its left extremity (splenic flexure) and to the predominantly more or less fixed position of its right extremity (below the neighborhood of the proximal half of the antrum of the stomach).

The fixation of the left extremity at or medad to the splenic flexure, is due to the diminishing depth of the transverse meso and the gastrocolic ligament, and to the uniform presence of the sustentaculum lienis.

The fixation of the right extremity, at or a little to the right or left of the proximal half of the antrum of the stomach, is due not only to decreasing depth of the transverse meso but also to the almost uniformly shallow depth of the gastrocolic ligament below the antrum, as contrasted with the constant deepening of these peritoneal folds below the body of the stomach where they enter into one or more redundant loops.

In proportion as irregularity of adhesion of these major peritoneal folds is more pronounced, there is a tendency to secondary fixation, with the resulting formation of more than 1 larger or smaller fixed loops.[38]

In proportion as the right point of fixation of the loop moves to the right of the midantrum the subcystico-duodeno-pyloric transverse colon enters into the composition of the loop.

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37. In the 4 redundant cases in which the lower end was not distinctively fixed at this latter point, this condition was due to the descending and sigmoid mesos being continuous (9-XLVIII, 8-XLI, 8-XLIV, 7-XLVII). But in all but 1 of these 4 cases (9-XLVIII) the fixed loop was definitely formed above the crest and the undifferentiated meso was only a few mm. in depth. This last case was also the only one raising the question whether the sigmoid colon might not form part of the loop. These 4 cases may be compared with the 2 non-redundant cases in which a similar continuity of these two mesos persists (9-XLV, 5-XVI).

38. Larger loops are seen in 3 cases (9-XXV, 9-XXXVII, 7-XVIII) and suggested in 2 other cases (9-XXII, 9-XLVIII) in which all details of adhesion are not noted; smaller loops forming larger or smaller ripples are noted in 5 cases (0-XL, 9-XLV, 9-XLVI, 8-XLI, 7-XLVII). In 8-XLIV, 2 loops were found but it is noted that they may be converted into 1 by unfolding the meso and gastrocolic ligament which lie fulled-up at the point of junction of the two loops.

RELATION OF THE SUBGASTRIC TRANSVERSE COLON FIXED LOOPS TO THE BODY AND ANTRUM OF THE STOMACH. (Table XI)

In all of the 26 cases the fixed loop or loops of the subgastric transverse colon affect the body of the stomach.

In 17 of these cases the same loop affects also more or less of the proximal portion of the antrum (10 cases), the neighborhood of the pylorus (4 cases) and the 1st portion of the duodenum (3 cases).[39]

In the remaining 9 of the 26 cases the loop below the body of the stomach does not quite extend to the antrum, its right limb being attached at the antrum-body junction (6 cases), or to the left of this point (3 cases).

In 2 of the 12 cases at term and in 2 fetal cases, the loop below the body of the stomach does not extend on the left to the splenic flexure.

THE SUBCYSTICO-DUODENO-PYLORIC TRANSVERSE COLON.

In each of the 13 redundant cases (7 out of 14 at term; 6 out of 12 fetal cases), the subcystico-duodeno-pyloric transverse colon forms, or helps to form, at least 1 fixed loop, owing to the practically uniform more or less fixed positions of its two extremities.

The fixation of the left extremity below the pyloric half of the antrum of the stomach is due not only to the decreasing depth of the transverse meso, but also to the almost uniformly shallow depth of the gastro-duodeno-colic ligament below the 1st portion of the duodenum and the antrum, as contrasted with the constant greater or less deepening of these peritoneal folds to the left of this region.

The fixation of the right extremity below the gall bladder and anywhere along the 1st portion of the duodenum, is due to the same shallowing of these major peritoneal folds in the latter region, and to the attachment of the colon below the gall bladder to the cystico-colic ligament or to an analogous peritoneal extension from the lesser omentum.

In proportion to the amount of redundancy and to the irregularity of the adhesion of the above major peritoneal folds, there is a tendency to secondary fixation with the resulting formation of one or more secondary fixed loops.

In proportion as the left point of fixation moves to the left (towards the proximal portion of the antrum or even the body of the stomach), the subgastric transverse colon enters into the composition of the loop in the median abdomen.[40]

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[39] In the last 7 cases (in which the subgastric loop extends to the right beyond the midantrum), the loop is completed to the right by the subcystico-duodeno-pyloric transverse colon. In 2 other cases (9-XXV, 7-XVIII), following irregular adhesion of the transverse meso and the gastrocolic ligament, the main subgastric loop is apparently continued to the right beyond the midantrum in a secondary loop, the subcystico-duodeno-pyloric transverse colon completing to the right this secondary loop.

[40] One fixed loop is formed by this portion of the colon alone in 4 cases at term; and part of a loop is formed in 6 cases, the loop being completed to the left by the subgastric transverse colon (2 at term, 4 fetal cases). One fixed loop and part of a second loop are formed by this portion of the colon in 3 cases, the second loop being completed to the left by the subgastric transverse colon (1 at term, 2 fetal cases).

RELATION OF THE FIXED LOOPS TO THE GALL BLADDER, THE FIRST PORTION OF THE DUODENUM AND THE PYLORUS. (Table XI)

(*a*) *The Gall Bladder.*

In 8 of the 13 redundant cases, a fixed loop is found connected more or less with the gall bladder, one or both limbs of the loop being attached to the cysticocolic ligament (6 at term, 2 fetal cases).

(*b*) *The 1st Portion of the Duodenum.*

In 10 of the 13 redundant cases at least one limb of a fixed loop (in 8 cases the right limb; in 1, the left; in 1, both limbs) is attached below the 1st portion of the duodenum (6 at term, 4 fetal cases).

(*c*) *The Pylorus.*

In 9 of the 13 redundant cases, the fixed loop formation is definitely related to the pylorus (4 at term; 5 fetal cases).

Summarizing the foregoing relations, one notes that the fixed loops have one or both limbs attached below:

the gall bladder alone in 2 cases;
the gall bladder and the 1st portion of the duodenum in 6;
the 1st portion of the duodenum, apart from the gall bladder, in 7;
the pylorus, or just to the right or left of it, in 9.

THE SUBHEPATIC TRANSVERSE COLON.

In the 9 redundant cases (5 out of 14 at term, 4 out of 12 fetal cases), the subhepatic transverse colon forms at least 1 fixed loop—owing to the practically uniform fixation of the beginning and termination of this portion of the colon, *i. e.*, below the gall bladder, and at the hepatic flexure in the neighborhood of the upper part of the right kidney.

The fixation of the left extremity continues or coincides with the fixation of the right extremity of the subcystico-duodeno-pyloric transverse colon.

The fixation of the right extremity is due to the fixation of the hepatic flexure, the point of differentiation between the transverse and the ascending colons. This flexure is fixed by adhesion of the common meso, by vestiges of the great omentum, by minor extensions of the neighboring peritoneum, and occasionally (4 out of 26 cases) by a left phrenico-colic ligament (sustentaculum hepatis).

The loop or loops may be potential, *i. e.*, they may lie fulled-up in larger or smaller ripples, or they may be more or less unfolded and defined.[41]

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[41] If the line of adhesion of the meso is irregular, the ripples may be fixed (9-XXXVII, 4-XVII). If no secondary fixation of the meso occurs, the whole of this portion of the colon forms one fixed loop of greater or less depth according to the depth of its meso (7 of the 9 redundant cases). This loop may be potential or it may be more or less unfolded. It may form a U-loop with base directed downward and inward (6-XLIII), or an inverted-U with base directed upward (9-XXV), or upward and outward (8-XLI, 5-XXIX); or it may form two or more small oblique U's (9-XXVIII, 9-XXXVII, 4-XVII) or two more or less horizontal U's (0-XXVII, 9-XLII), these oblique and horizontal U's having their bases in opposite directions.

THE ASCENDING COLON.

In each of the 9 redundant cases (7 out of 14 at term, 2 out of 10 fetal cases), this portion of the colon tends to form at least 1 more or less fixed loop.

When a meso is present the ascending colon in its entirety tends to form a primary fixed loop, owing to the fixation of its upper extremity at the hepatic flexure and to the limitation of its lower extremity by the cecum.

This primary fixed loop is found in varying forms.[42,44] But the progressing though irregular adhesion of the ascending meso tends to make one or more secondary more or less fixed loops somewhere along the course of this portion of the colon.[45] And the cecum, and even the terminal ileum may be included in a loop, since the ascending meso, the mesocecum and (more rarely) the mesentery may remain continuous.[43] The loops formed depend upon the amount of redundancy of this portion of the colon as well as upon the degree of irregularity of adhesion of its meso.[45,46]

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[42] In 8-XLIV, the ascending meso varies from 3 mm. at its lower end to 12 mm. at its upper end, the whole ascending colon arching forward and upward and forming a redundant inverted U-loop high up under the liver.

[43] In 9-XXVIII and 9-XLII, the cecum is included in the primary loop, the ascending meso and the mesocecum being continuous, and both varying in depth up to 15 mm. in the former case, while in the latter case the depth of the mesocecum is 15 mm. and that of the ascending meso has a maximum of 10 mm.

In 9-XXII, not only the cecum but also the terminal ileum is included in the primary loop, the ascending meso, the mesocecum and the mesentery being continuous. In this case, the lower half of the ascending colon and the cecum (with the terminal ileum) are displaced upward and inward, forming a horizontal S in the right abdomen above the level of the umbilicus.

[44] Transitional stages are illustrated in 8-XLI in which through adhesion of the meso the primary loop has almost disappeared but an ascending meso of 2 to 5 mm. remains, as does a mesocecum of 5 mm. In the process of adhesion a fixed secondary loop has been developed upon and outside of the lower third of the kidney. This loop is 10 mm. deep and its limbs are connected by a fold of peritoneum 2 or 3 mm. in width.

[45] These loops may be potential, *i. e.*, they may lie fulled-up in larger or smaller ripples, or they may be more or less unfolded and defined. If the irregularity of adhesion is very diffused, the loops may be small and fixed, forming a larger or smaller fixed ripple (0-XL, 9-XXXVII). If the irregularity of adhesion is less diffused, a fixed loop results. This loop may be potential (9-XXVIII), or it may form a U-loop with base directed upward (9-XXII, 8-XLIV), or downward and outward (0-XXVII, 8-XLI), or downward and inward (9-XLII, 9-XLVI), or it may form an unfixed ripple which has potentialities of forming a loop directed downward and inward (9-XXVIII).

[46] In 1 case (0-XL) in which the redundant ascending colon makes 2 fixed U's whose bases are directed inward, it shares (with the non-redundant but transverse subhepatic transverse colon) in the formation of a higher fixed U-loop whose base is directed outward, this latter loop lying in the extreme upper right abdomen. In 1 non-redundant case (9-XLVIII), the ascending colon continues to the left with the subhepatic and the subcystico-duodeno-pyloric transverse colons, forming a more or less fixed inverted U-loop in the extreme upper right abdomen.

DISTENSION (DILATATION?) OF THE PROXIMAL COLON: DAMMING BACK OF MECONIUM, WITH DISTENSION OF THE PROXIMALLY ADJACENT INTESTINE. (Table X)

In 8 of the 14 cases at term and in 1 of the 13 fetal cases, the descending colon is unusually distended with meconium so that it resembles the sigmoid colon in size (this latter portion of the colon in these cases being also unusually distended with meconium).

In 3 of the 8 cases at term (0-XXVII, 0-XL, 9-XXXVIII) a similar unusual distension of the subgastric transverse colon is noted, and in at least the last 2 of these cases dilatation is suggested.

In 0-XL the back pressure apparently extends to the subcystico-duodeno-pyloric transverse colon and to more or less of the subhepatic transverse colon, since these portions also show unusual distension, suggesting dilatation, and are filled with meconium.

No undue distension of the ascending colon or of the cecum was noted in any case.

In 3 of the above 8 cases at term and in 2 fetal cases, the ileum was markedly distended and it contained meconium, while in 1 of these cases (9-XXXVII) the 1st and 2nd portions of the duodenum were dilated to the usual size of the colon, and in 1 other of these cases (O-XL) the stomach also contained meconium.[47]

With reference to the relation of redundancy and over-distension—in 4 of the 9 distended cases the descending colon is redundant; in the 3 distended subgastric transverse colon cases all are redundant; the 1 distended subcystico-duodeno-pyloric transverse colon is redundant; in the 1 distended subhepatic transverse colon there is no redundancy.

The relation of redundancy to the type of sigmoid colon shows a similar lack of definite relativity—4 of the 9 distended cases being of the 1st type, 3 of the 2nd, 1 of the 3rd, while the remaining 1 is either the 2nd or 3rd type.

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[47] In connection with the question of backward overflow of meconium when the limits of distension of the more distal intestine are reached, it seems pertinent to note details in some of these cases:

In 0-XL, the distended (with meconium and gas) sigmoid and descending colons fill the whole of the left side of the abdomen, forming an enormous reversed S, lying obliquely, and with the curves all in apposition. Empty and collapsed, with its walls in apposition, the width of the sigmoid colon varies from 30 to 42 mm.

In 9-XXXVII, the lower part of the descending colon is distinctly dilated, the other parts of the colon proximal to this are small and the walls are thicker and more rigid than usual.

In 9-XLVIII, from the lower fourth of the left kidney downward the descending colon cannot be distinguished in size from the distended sigmoid colon.

In 5-XXIX, the descending colon is so distended and filled with meconium that at first sight it looks like the distended sigmoid colon.

In 5-XI, owing to deficient distensibility of the entire colon (this being throughout about the size of the small intestine), backward overflow seems to occur into the small intestine— a dilated loop of ileum fills the right iliac region while most of the ileum is larger and darker than usual and contains meconium.

LONGITUDINAL MUSCLE BANDS

In 1 of the 27 prenatal cases, longitudinal muscle bands are absent in the sigmoid colon and in the redundant loops of the rest of the colon but they are unusually well-marked in the non-redundant parts (9-XLII). This case had redundant loops in the descending, subgastric, subhepatic and ascending colons, the depth of these loops varying as 12, 40, 8 and 10 mm., respectively, while the sigmoid colon was of the 1st type.

In 1 case the cecum shows no trace of longitudinal muscle bands (9-XLV).

SACCULATIONS

Sacculations are more or less definitely marked in 3 cases at term and in 3 fetal cases.[48]

PERITONEAL FOLDS ATTACHED TO THE PROXIMAL COLON: MESOS; GASTRO-COLIC LIGAMENT; GASTRO-DUODENO-COLIC LIGAMENT; GREAT OMENTUM; PHRENICO-COLIC LIGAMENTS; CYSTICO-COLIC LIGAMENT; DEVELOPMENTAL ADVENTITIOUS FOLDS. (Plates V, VI; Figs. 7, 9)

THE SIGMOID COLON.—Occurrence, Depth, Adhesion and Differentiation of the Sigmoid Meso (p. 190).

THE DESCENDING COLON.—Occurrence, Depth, Adhesion and Differentiation of the Descending Meso.

The redundancy of the descending colon is correlated with redundancy of the visceral border of the descending meso. In 2 of the 26 cases, the descending meso is entirely absent, adhesion being complete (0-XL, 9-XLVI). In the other 24 cases, it is present in some part of its course though sometimes only in the redundant loops, and its depth varies within rather wide limits, being greatest in the loops.[49]

An experimental explanation of the possible formation of colon sacculations is demonstrated on pp. 187-190.

In the 12 at term cases in which a meso is present, the maximum depth varies from a few mm. to 65 mm. (9-XV). In the 13 fetal cases a meso is always present, the maximum varying from a few to 15 mm. (7-XVIII).

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[48] In 9-XLV, sacculations are very distinctly indicated in the transverse colon, the descending colon and the greater part of the sigmoid colon, but they are less marked in the ascending colon.

In 9-XLVI and in 9-XLVIII, similar conditions exist throughout the colon; in the latter case they are most marked in the transverse colon, especially in the region of the loops to the left of the pylorus.

In 7-XLVII, there are suggestions of sacculations in the transverse colon.

In 5-XXIX, on inflation of the colon, suggestions of sacculations are seen to be developed irregularly throughout the tube.

In 5-XLIX, there were found such suggestions in the transverse and ascending colons, scarcely any in the descending colon, and none in the sigmoid colon.

[49] In 9-XLII, it is absent except in the redundant loop which is 12 mm. deep, In 3 cases, it is absent in certain areas—down to the lower fourth of the left kidney. where a large loop begins; in the middle of its course, between the two loops; and just below the splenic flexure, respectively (9-XLVIII, 8-XLIV, 5-XLIX).

The descending meso was always differentiated from the transverse meso at the splenic flexure. For differentiation of the descending meso from the sigmoid meso, see p. 190.

The Subgastric Transverse Colon.—The Subgastric Transverse Meso; Gastro-colic Ligament.

The redundancy of the subgastric transverse colon is correlated with redundancy of the visceral border of the subgastric transverse meso and with redundancy of the colic area of adhesion of the gastrocolic ligament.

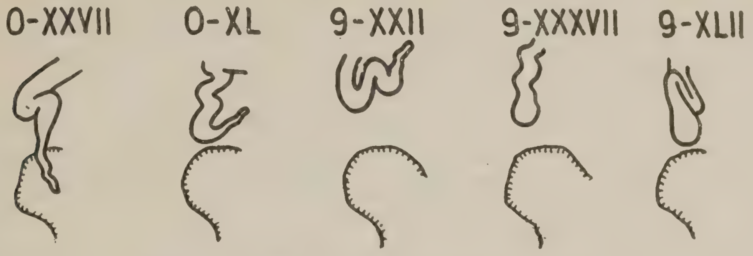

Fig. 7—Adventitious Types of Undescended Cecum.

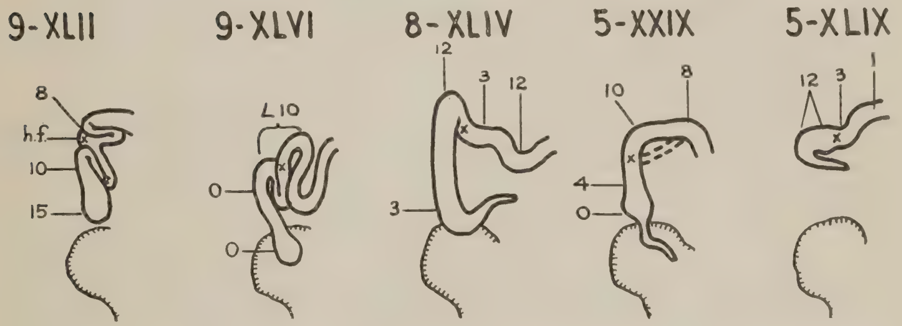

Fig. 9—Illustrating Some Variations in the Adhesion of the Mesos on both sides of the Hepatic Flexure (the figures refer to meso depths expressed in mm.).

The gastrocolic ligament is as a rule attached to the transverse colon, and it extends downward from the greater curvature of the stomach to the full extent of the redundant loops of this portion of the colon. This attachment was verified by inflating the lesser peritoneal cavity through the foramen of Winslow, when the gastrocolic ligament would blow out between its respective attachments to the stomach and the transverse colon in the form of a network of blood vessels, the meshes of which network were closed in by the fine, transparent peritoneal membrane which was so delicate that it was extremely difficult to handle without tearing.

This membrane ballooned out in the meshes as though held in restraint by the interlacing blood vessels.

Except where the redundant loops of the transverse colon hung downward, this membrane always tended to be folded upon itself between the greater curvature and the transverse colon, so that the latter lay rather closely along the course of the former.

Marked individual and regional variation is found in both of these peritoneal folds. For example, the subgastric transverse meso is at least deep enough, ventrad from the spine, to permit the subgastric transverse colon to lie more or less below the greater curvature of even the distended stomach, and both this peritoneal fold and the gastrocolic ligament extend downward into the full depth of the redundant loops. But in the non-redundant areas the depth of the gastrocolic ligament is sometimes so diminished as to be merely perceptible, *i. e.*, only a few mm.

Thus in O-XL, the gastrocolic ligament is 15 mm. in depth below the pylorus and antrum; it then rapidly decreases to the junction of the middle and distal thirds of the greater curvature; beyond that point it almost disappears, bringing the stomach and the transverse colon into close apposition.[50]

Realizing that a subgastric transverse meso of a few mm. would not permit the transverse colon to lie below the greater curvature of the empty stomach, let alone the latter in a condition of distension, one may form some idea of the variation of correlation in the depth of these two major peritoneal folds in such cases.

On the other hand, in many cases, especially where the left limb of the redundant loop rises more or less gradually to the splenic flexure (through decreasing depth of both peritoneal folds), the correlation in depth of these folds seems to be maintained.[51]

The general tendencies towards uniformity in the variation in depth of the transverse meso and the gastrocolic ligament below the greater curvature seem to be (1) In the direction of maximum depth below the body of the stomach, in the redundant loops; (2) In the direction of gradually decreasing depth to the left as the splenic flexure is approached; and

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[50] Among other cases in this group may be noted the following:—

In 9-XLVI, the gastrocolic ligament is very shallow in depth below the antrum; it then increases to a maximum of 13 mm., decreasing rapidly to 3 mm. at the left side of the slightly distended stomach.

In 7-XVIII, the gastrocolic ligament is 3 mm. in depth below the pylorus and 5 mm. just to the left of the antrum-body junction, between the median and left loops, the depth of these latter being 10 and 25 mm. respectively.

In 4-XXIII, the gastrocolic ligament is 2 or 3 mm. in depth at the pylorus; it then increases to reach a maximum of 10 mm. below the body of the stomach, decreasing to 4 mm. as the splenic flexure is approached.

[51] Among cases in this group may be noted the following:—

In 9-XLV and 6-XLIII, the loop gradually decreases in depth to the splenic flexure.

In 9-XLII and 7-XLVII, the loop decreases rapidly in depth as it approaches the splenic flexure.

(3) In the direction of more rapidly decreasing depth to the right towards the proximal antrum.

In all cases, as above stated, the depth of the subgastric transverse meso is at least sufficient to allow the subgastric transverse colon to lie below the greater curvature of the stomach even when the latter is distended. From this minimum, it varies so as to permit of loops being formed up to 45 mm. or more in depth.

The depth of the gastrocolic ligament shows more irregularity. While its maximum is correlated with the maximum of the transverse meso so far as to enter with this latter fold into the formation of the deepest loops, such correlation may not continue proportionately, thus introducing a new factor in the relation of the transverse colon to the stomach.

The gastrocolic ligament is found varying in depth from an extent sufficient to form a redundant loop 45 mm. or more in depth down to a merely perceptible minimum of a few mm.[52]

The locations of the maxima of both of these peritoneal folds are always in the redundant loops. The principal locations of the minima are at or toward the splenic flexure and at or towards the proximal antrum, but additional minima may occur also between these points.

There seems to be a tendency for the minimum depth of these peritoneal folds at the right extremity of this portion of the colon to move towards the left more definitely at term than in the fetal cases, thus moving in the direction of restricting the subgastric loop towards the body of the stomach.[53]

When the subgastric transverse colon is fulled-up towards the greater curvature of the stomach, the transverse meso and the gastrocolic ligament are fulled-up above or behind this portion of the colon. When the loops are unfolded and hanging down, these two peritoneal folds are also unfolded and hanging down.

THE SUBCYSTICO-DUODENO-PYLORIC TRANSVERSE COLON—SUBCYSTICO-DUODENO-PYLORIC TRANSVERSE MESO; GASTRO-DUODENO-COLIC LIGAMENT; INTER-ADHESION OF THESE TWO FOLDS.

The redundancy of the subcystico-duodeno-pyloric transverse colon is correlated with redundancy of the visceral border of the related transverse meso and with redundancy of the related colic area of adhesion of the gastro-duodeno-colic ligament.

Individual and regional variation in depth is found in both of these peritoneal folds, this variation being especially marked in the redundant cases.

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[52] At term its minimum is noted as varying from 3 to 6 mm. and its maximum as varying from 13 to 45 mm. or more. In the fetal cases its minimum is noted as varying from 1 to 5 mm. and its maximum from 9 to 45 mm.

[53] Thus, the right limb of the subgastric loop has its base fixed below or to the left of the body-antrum junction in 7 cases at term and in 2 fetal cases, below the proximal antrum in 5 cases at term and in 5 fetal cases, and at a varying distance to the right of the midantrum in 2 cases at term and in 5 fetal cases.

In the 13 non-redundant cases, both the subcystico-duodeno-pyloric transverse meso and the related gastro-duodeno-colic ligament continue to show some of the individual and regional variation which is so marked a feature of the subgastric area, this indicating some continuing irregularity of adhesion; but the average depth of both folds is markedly decreased below the average of that found in the subgastric area, the special decrease in depth tending to begin as the antrum is approached and to progress rapidly towards the right. The irregularity of adhesion varies more or less, but as in these cases the related colon is not redundant this variation alone does not result in the formation of a definite loop.[54]

In the 13 redundant cases, the redundancy of this portion of the colon is sufficiently pronounced to make definite loop formations.

In 3 of these 13 cases the whole of this portion of the colon forms one primary loop which is continued more or less into the subgastric transverse colon. In 3 others, only the left extremity of this portion of the colon is redundant enough to enter into the formation of a loop which is made almost entirely by the subgastric transverse colon. In the remaining 7 cases, the adhesion of both the related transverse meso and the gastro-duodeno-colic ligament is so irregular that loops are formed in various places along the course of this portion of the colon, *i. e.*, from the pyloric antrum to the gall bladder. Between these loops, these major peritoneal folds tend to reach the decreased depth found in the non-redundant cases, hence the loops are fixed loops.[55]

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[54] A few examples will illustrate the average variation in depth of the gastro-duodeno-colic ligament in this group of cases:—

In 9-XXII, the gastrocolic ligament has a maximum depth of 37 mm. below the body of the stomach, but it decreases to 3 or 4 mm. below the antrum and the 1st portion of the duodenum.

In 9-XLII, from a maximum of 20 mm. below the body of the stomach it decreases to 3 or 4 mm. below the antrum and pylorus, increasing to 6 mm. below the 1st portion of the duodenum.

In 9-XLV, it has a maximum depth of 25 mm. in the subgastric loop, decreasing to 3-5 mm. below the lower border of the stomach, the antrum and the 1st portion of the duodenum.

In 8-XLI, from a maximum of 45 mm. below the stomach, its depth decreases rapidly to the body-antrum junction; from here, it decreases slowly along the antrum reaching 4 or 5 mm. below the pylorus and the 1st portion of the duodenum.

In 5-XVI, from a maximum of 19 mm. below the body-antrum junction, its depth rapidly diminishes below the antrum, becoming 3-4 mm. below the pylorus and 1st portion of the duodenum.

In 9-XXXVIII, 9-XXXIX, 6-XIV, 4-XVII, and 4-XXIII, from maxima below the body of the stomach which vary from 45 to 10 mm. it diminishes rapidly so that below the distal portion of the antrum, the pylorus and the 1st portion of the duodenum the depth is only a few mm.

[55] A few examples will illustrate the average variation in depth of the major peritoneal folds in this group of cases:—

In 0-XXVII, the transverse meso and gastrocolic ligament do not diminish in

A noticeable feature of the peritoneal connection in this area, between the transverse colon on the one side and the antrum and the 1st portion of the duodenum on the other side, is that it appears to be firmer and denser than in the subgastric region. This appearance may be the result of more or less adhesion between the two folds, it being difficult or impossible to separate them in this region (a similar adhesion and increase in density is observed in the peritoneal folds where the great omentum becomes vestigial to the left). This appearance does not extend into the redundant loops.

The Subhepatic Transverse Colon—Termination and Depth of the Subhepatic Transverse Meso; Variation in the Adhesion of Mesos on both Sides of the Hepatic Flexure.

The termination (right extremity) of the subhepatic transverse meso depth at the antrum, but they decrease gradually below the 1st portion of the duodenum as the gall bladder is approached—the whole of the transverse colon forming an arc of an ellipse which extends from the splenic flexure to the gall bladder.

In 0-XL, the subgastric transverse colon loop is continued to the right, the gastrocolic ligament reaching its maximum of 15 mm. below the antrum and pylorus; it then rapidly decreases below the 1st portion of the duodenum as the gall bladder is approached.

In 9-XXV, the transverse meso and gastrocolic ligament are deep enough to form a loop 15 mm. in depth below the antrum, pylorus and adjacent part of the 1st portion of the duodenum, then decreasing to a few mm. below the latter, and later increasing to permit of another loop 15 mm. deep below the gall bladder.

In 9-XXVIII, the transverse colon is closely attached to the antrum, but it forms a small loop between the pylorus and the gall bladder.

In 9-XXXVII, it is closely attached to the antrum and 1st portion of the duodenum, lying in a small fixed ripple below the latter and forming a small fixed loop just to the left of the gall bladder.

In 9-XLVI, it is closely attached to the antrum, pylorus and 1st portion of the duodenum, but below the gall bladder it falls in a fixed loop which is 28 mm. in depth.

In 9-XLVIII, the gastrocolic ligament is 6 mm. deep below the antrum, rapidly increasing to 18 mm. in the loop below the pylorus, then rapidly decreasing to 6 mm. below the 1st portion of the duodenum.

In 8-XLIV, the subgastric transverse meso and gastrocolic ligament do not diminish in depth at the antrum, but gradually decrease to 3 mm. at the right end of the 1st portion of the duodenum, making one continuous festooning from this latter point to the splenic flexure, the maximum depth being 12 mm.

In 7-XVIII, below the antrum the gastrocolic ligament decreases rapidly from 25 mm. to 3 mm. at the pylorus, immediately rapidly increasing to 10 mm. in the loop below the 1st portion of the duodenum, and again rapidly decreasing as the gall bladder is approached.

In 7-XLVII, the gastrocolic ligament is 9 mm. deep in the loop below the antrum, decreasing to 2 mm. below the pylorus and immediately increasing rapidly below the 1st portion of the duodenum so that a loop 15 mm. deep lies below the gall bladder.

In 6-XLIII, 5-XXIX and 5-XLIX, the subgastric transverse colon and gastrocolic ligament decrease rapidly below the antrum but reach their minimum at the pylorus or a little to the left or right of this latter; the minimum depth of the gastrocolic ligament is then continued to the right below the 1st portion of the duodenum, being scarcely perceptible (1 mm.) in 6-XLIII and 5-XLIX, and 8 mm. in 5-XXIX.

shows some variation in location even in the non-redundant cases. This is the right end of the transverse meso, a peritoneal fold which predominantly tends to decrease in depth to the right of the median line and to disappear entirely as the hepatic flexure is reached. In this study, such disappearance was noted as occurring at various points from the outer edge of the 2nd portion of the duodenum (0-XL) to the outer border of the right kidney (9-XXII, 9-XXXVII, 9-XXXIX).

In the redundant cases the meso persists, its depth varying up to a maximum of 18 mm. and decreasing rapidly as the hepatic flexure is approached. But in 3 of the non-redundant cases (as well as in 2 of the redundant cases) mesos were noted as persisting irregularly on both sides of the flexure (Fig. 9).

THE ASCENDING COLON.—OCCURRENCE, DEPTH, ADHESION AND DIFFERENTIATION OF THE ASCENDING MESO.

In 2 out of 16 cases (10 at term, 6 fetal cases), the ascending meso is entirely absent, adhesion being complete (9-XXXIX, 5-XVI). In the other 14 cases it is present in some part of its course though sometimes only in the redundant loops, its depth varying within not very wide limits.[56]

The line of adhesion of the ascending meso is very variable. Thus in 0-XL and 9-XXXVII, there is no meso except in the redundant loops which cannot be moved along—in the latter case the loops are only a few mm. in depth, in the former they are 8 to 10 mm. deep.[57]

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[56] In the 9 cases at term in which some meso is present, the maximum depth varies from a few to 15 mm. (9-XXVIII). In the 5 fetal cases in which some meso is present, the maximum depth varies from a few to 12 mm. (8-XLIV).

[57] Rather frequently the adhesion of the meso is definitely more marked in the lower course of this portion of the colon. Thus there is a meso on both sides of the hepatic flexure in 9-XLVI and 5-XXIX, and the depth of the ascending meso decreases from above downward—from 10 mm. (in the fixed loop) to 0 in 9-XLVI, and (though there is no redundancy) from 10 mm. to 4 mm. in 5-XXIX. Again, in 9-XLV, another non-redundant case, it decreases from 3 mm. to 0; and in 8-XLIV, a redundant case, from 12 mm. (in the loop) to 3.

But sometimes the opposite course is followed and the ascending meso may even be continuous with the mesocecum. Thus in 9-XXII (redundant), the ascending meso increases from above downward, from 0 to 10 mm., being continuous with a mesocecum of the same depth, and the latter being directly continous with the mesentery.

In 9-XXVIII (redundant) both ascending meso and mesocecum vary irregularly up to 15 mm. In 9-XLII (redundant) in which there is a meso on both sides of the hepatic flexure, the ascending meso is 10 mm. deep and the mesocecum 15 mm. In 8-XLI (redundant) the depth of the meso is 2 mm. increasing suddenly to 5 mm. at the cecum, and being 10 mm. in the fixed loop just above the cecum. In 9-XLVIII (non-redundant) there is no ascending meso till the cecum is approached, then one is found and it is continuous with the mesocecum, the latter being 21 mm. in depth and directly continuous with the mesentery.

There seems to be some tendency towards unity in the adhesion of the ascending

THE CECUM.—OCCURRENCE, DEPTH, ADHESION AND DIFFERENTIATION OF THE MESCO-CECUM.

In 4 out of 17 records (2 out of 10 at term, 2 out of 7 fetal cases) the mesocecum is entirely absent: 9-XLV, 9-XLVI, 5-XVI, 5-XXIX. In the remaining 13 cases, it varies in depth from "very short" to 21 mm.[58]

THE GREAT OMENTUM.—LIMIT OF EXTENSION OF RIGHT EDGE ALONG THE COLON.

That portion of the great omentum hanging free below its attachment to the transverse colon was usually found rolled up and lying above the transverse colon, between this viscus and the stomach, but occasionally it extended downward over the transverse colon. Its right edge was found at varying distances along the colon from the line of the gall bladder nearly to the ileo-colic junction.[59]

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meso and of the mesocecum. Thus in 9-XXVIII both vary in depth up to 15 mm., and in 5-XVI both are absent. In 9-XLV the depth of the ascending meso from above downward varies from 3 mm. to 0, and the mesocecum is absent; in 9-XLVI the meso varies in the same way from 10 mm. to 0 and the mesocecum is absent; in 5-XXIX the meso varies in the same way from 10 mm. to 4 mm., and the mesocecum is absent; in 8-XLI the meso varies from 2 to 5 mm. and the mesocecum is 5 mm.

But this unity is not always apparent and a mesocecum of considerable depth may be present when the ascending meso is absent or insignificant. Thus, in 9-XXXIX the ascending meso is absent while a mesocecum is present, though not of any great depth. In 0-XL and 9-XXXVII the ascending meso is absent except in the fixed redundant loops (where it varies from a few to 10 mm.) but a mesocecum is present In 9-XLII the depth of the ascending meso is 10 mm. and that of the mesocecum is 15 mm. In 9-XLVIII there is no ascending meso till the cecum is approached but the mesocecum is 21mm. deep and it is continuous with the mesentery.

Thus, differentiation between the ascending meso and the mesocecum is found in 8 out of 16 cases (6 out of 10 at term, 2 out of 6 fetal cases), the differentiation being due to adhesion of the ascending meso alone, either entirely or adjacent to the cecum in 4 of the 8 cases (0-XL, 9-XXXVII, 9-XXXVIII, 9-XXXIX), to adhesion of the mesocecum alone in 1 case (5-XXIX), and to adhesion of both adjacent ascending meso and mesocecum in 3 cases (9-XLV, 9-XLVI, 5-XVI).

58. The mesocecum is noted as being directly continuous with the ascending meso (q. v.) in 7 cases (9-XXII, 9-XXVIII, 9-XLII, 9-XLVIII, 8-XLI, 7-XLVII, 6-XLIII), and as being directly continuous with the mesentery is 2 of these 7 cases (9-XXII, 9-XLVIII).

59. In 3 cases, the right edge of the great omentum is noted as being related to the neighborhood of the junction of the subcystico-duodeno-pyloric transverse and the subhepatic transverse colons (terminating at the right mammillary line in 0-XL, at the attachment of the cystico-colic ligament in 7-XLVII, and just to the right of this attachment in 5-XLIX). In 1 case (8-XLI), it extends nearly to the hepatic flexure. In 3 cases, it extends along the ascending colon as far as from 5 to 7 mm. above the ileo-colic junction (0-XXVII, 9-XXXVIII, 9-XLVIII).

THE LEFT PHRENICO-COLIC LIGAMENT (SUSTENTACULUM LIENIS).

This was found in all 26 prenatal cases.

THE RIGHT PHRENICO-COLIC LIGAMENT (SUSTENTACULUM HEPATIS).

This peritoneal fold is found in 3 out of 26 cases, (0-XL,[60] 9-XLII, 7-XLVII).

CYSTICO-COLIC LIGAMENT.

In 13 out of 14 cases at term and 11 out of 12 fetal cases, the transverse colon is noted as being connected with the transverse fissure of the liver by a fold of peritoneum which is more or less continuous with the lesser omentum, and which is usually also more or less connected with the gall bladder, and with the 2nd portion of the duodenum.

In 22, this fold answers to the anatomic description of the cystico-colic ligament. In 2 (9-XLV; 7-XLVII), there is no definite cystico-colic ligament, but a peritoneal fold passes from the lesser omentum to the transverse colon. In the remaining 2 cases (9-XLVIII; 4-XXIII), the cystico-colic ligament appears to be absent.

DEVELOPMENTAL ADVENTITIOUS PERITONEAL FOLDS.

See later paragraph (Pathologic Variations noted).

ANATOMIC VARIATIONS NOTED IN THE PROXIMAL COLON: GREATEST UNIFORMITY.

Anatomic variations exist in practically every detail of the proximal colon. In the various portions the greatest tendency to uniformity which is found is here noted.[61]

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[60] In 0-XL, the sustentaculum hepatis is atypical, a peritoneal fold beginning at the junction of the ascending colon with the cecum and being attached to the postero-lateral abdominal wall, just above the lower edge of the liver, where it seems to form a sustentaculum hepatis. On this, the uppermost elbow of the ascending colon (formed at the hepatic flexure) and the lower edge of the liver rest as on a hammock. This fold forms a peritoneal veil over the outer part of the next lower elbow of the ascending colon.

[61] *The Descending Colon.*

In the differentiation of the descending meso from the transverse meso at the splenic flexure (14 out of 14 at term, 12 out of 12 fetal cases);

The parietal attachment of the descending meso—down the left side of the abdomen, along the outer border of the kidney, from the splenic flexure to the crest of the left ilium (14 out of 14 cases at term, 9 out of 12 fetal cases);

The incomplete adhesion of the descending meso—(12 out of 14 cases at term, 12 out of 12 fetal cases);

The differentiation of the descending meso from the sigmoid meso at the crest of the left ilium (12 out of 14 at term, 8 out of 12 fetal cases);

The tendency to decrease of redundancy as term is approached (non-redundant in 9 out of 14 at term, 6 out of 12 fetal cases);

The presence of the longitudinal muscle bands—(absent only in the redundant loop of 1 case at term);

The absence of sacculations—(distinctly indicated in only 1 case at term, and suggestions of beginnings of such in 1 case at term and 2 fetal cases).

The Subgastric Transverse Colon.

In the existence of redundancy, with the formation of at least one large fixed loop which is either potential (fulled-up in small coils below the greater curvature) or unfolded and extending downward in the abdomen (14 out of 14 at term; 12 out of 12 fetal cases);

The tendency to the location of a loop just to the right of the splenic flexure, in the line of the vertical external border of the stomach (9 out of 14 at term; 7 out of 12 fetal cases);

The restriction of the distribution of this division of the colon to the left or left and median abdomen (14 out of 14 at term; 12 out of 12 fetal cases);

The presence of the splenic flexure and of the phrenico-colic ligament or sustentaculum lienis (14 out of 14 at term; 12 out of 12 fetal cases);

The tendency to fixation of the right extremity below or to the left of the proximal portion of the antrum of the stomach (12 out of 14 at term, 7 out of 12 fetal cases);

The existence of angulation (present or potential) at the left extremity at or medad to the splenic flexure (14 out of 14 at term; 12 out of 12 fetal cases);

The predominant tendency, when unfolded, to the formation of angulation at the right extremity, below or to the left of the proximal portion of the antrum (12 out of 14 at term; 7 out of 12 fetal cases);

The predominant marked diminution in depth of the gastrocolic ligament in the neighborhood of the proximal portion of the antrum, and also below the body of the stomach as the splenic flexure is approached;

The presence of the longitudinal muscle bands (absent only in the redundant loops of 1 case at term);

The absence of sacculations (distinctly indicated in only 1 case at term, suggestions of beginnings of such in 2 cases at term and 3 fetal cases).

The Subcystico-duodeno-pyloric Transverse Colon.

In the practically fixed position of this portion of the colon (7 out of 14, and parts of the other 7, at term; 6 out of 12 fetal cases, and parts of the other 6);

Its predominant restriction to the median half of the right upper quadrant of the abdomen both at term and in the fetal cases;

Its tendency to be closely connected with the pyloric antrum and the 1st portion of the duodenum through greatly diminished depth of the related transverse meso and gastro-duodeno-colic ligament (12 out of 14 at term; 11 out of 12 fetal cases);

Its close connection with the transverse fissure of the liver with the gall bladder and with the 2nd portion of the duodenum, through the lesser omentum and the cystico-colic ligament (13 out of 14 at term; 11 out of 12 fetal cases);

The tendency of the peritoneal connection between this portion of the colon and the pyloric antrum and the 1st portion of the duodenum to be less transparent and denser than the gastrocolic ligament in the subgastric area;

The presence of longitudinal muscle bands (not absent in any case);

The absence of sacculations (distinctly seen in only 1 case at term, suggestions of beginnings of such in 2 cases at term and 3 fetal cases).

The Subhepatic Transverse Colon.

In the practically fixed position of this portion of the colon, with consequent localization of its redundancy—between the gall bladder and the upper part of the right kidney, *i. e.*, above or to the left of the hepatic flexure (14 out of 14 at term, 11 out of 12 fetal cases);

Its restriction to the outer part of the right upper quadrant of the abdomen—under the dome of the liver (14 out of 14 at term, 12 out of 12 fetal cases);

The presence of the hepatic flexure as a perceptible angle on the upper part of the right kidney (13 out of 14 at term; 10 out of 12 fetal cases);

PATHOLOGIC VARIATIONS NOTED IN THE PROXIMAL COLON.

Pathologic variations, or possibilities, are noted in the direction of marked distension (dilatation?); of marked contraction (localized or diffused); of the developmental formation of fixed loops; of the developmental formation of a peritoneal veil; and of angulation and kinking.[62]

The predominant absence of the sustentaculum hepatis (present in 2 out of 14 cases at term; 1 out of 12 fetal cases);

The presence of longitudinal muscle bands (14 out of 14 at term; 12 out of 12 fetal cases);

The absence of sacculations (more or less distinctly seen in 1 case at term, suggestions of beginnings of such in 1 other case at term and in 3 of the 12 fetal cases).

The Ascending Colon.

In the differentiation of an ascending colon from a transverse colon (14 out of 14 cases at term, 10 out of 12 fetal cases);

Its location upon the right kidney in more or less of its course (14 out of 14 at term, 9 out of 10 fetal cases);

The location of the cecal end above the crest of the ilium (9 out of 14 at term, 6 out of 10 fetal cases);

The practically fixed position of this portion of the colon, with consequent localization of its redundancy between the cecum and the hepatic flexure (14 out of 14 at term, 10 out of 10 fetal cases);

The frequent presence of redundancy in the at term cases and its comparative absence in the fetal cases (more or less redundancy in 7 out of 14 at term, and in only 2 out of 10 fetal cases);

The termination of this portion of the colon at a more or less perceptible angle on the upper part of the right kidney (13 out of 14 at term, 7 out of 10 fetal cases);

Its restriction to the right lateral abdomen (14 out of 14 at term, 10 out of 10 fetal cases);

The presence of longitudinal muscle bands (14 out of 14 cases at term, 10 out of 10 fetal cases);

The absence of sacculations (fairly distinct in 1 case at term, suggestions of beginnings of such in 2 cases at term and 2 fetal cases).

[62] Distension so marked as to suggest dilatation is noted in the

Descending colon, in 8 out of 14 cases at term and 1 out of 13 fetal cases;

Subgastric transverse colon, in the whole portion in 2 cases (0-XXVIII, 0-XL), and in the redundant loop in 1 case (9-XXXVIII):

Subcystico-duodeno-pyloric transverse colon, in 1 case (0-XL);

Subhepatic transverse colon, in 1 case (0-XL);

In 3 of the above 8 cases at term and in 2 fetal cases, the ileum was markedly distended and it contained meconium, while in one of these cases (9-XXXVII) the 1st and 2nd portions of the duodenum were dilated to the usual size of the colon, and in 1 other of these cases (0-XL) the stomach also contained meconium.

Contraction—In the form of a localized marked diminution in calibre. In the

Descending colon—the upper part, in 1 case (9-XXXVII).

Subcystico-duodeno-pyloric transverse colon—for 10 mm. to the right of the median line, it is smaller than the small intestine, in 1 case (8-XLI).

In the form of a general diminution in calibre—in 1 case, the upper part of the descending colon and the rest of the colon proximal to this, are diminished in calibre and the walls are thicker and more rigid than usual (9-XXXVII). In 1 other case (5-XI) the whole colon is about the size of the upper small intestine.

(Further details of The Proximal Colon are noted under The Colon as a Whole in the chapters which follow).

THE PRENATAL COLON AS A WHOLE

Final Prenatal Disposition of the Colon

Parietal Attachment (Fig. 4).

Viewing the colon as a whole, one is struck with the final prenatal disposition of its parietal attachment around the periphery of the posterior abdominal wall, below the stomach and spleen and below most of the liver and pancreas—a far progression from its original location in the median sagittal plane. Traces of this progression have been noted in some of the details of this advanced arrangement which epitomizes the procession gradually emerging throughout the animal series.

Basic Redundancy. (Plates V, VI; Fig. 5).

A similar outline of the visceral attachment of the colon mesos with the colon connected, shows a visceral tracing which is a departure from

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Developmental formation of fixed loops—Occurs in all portions of the colon proximal o the sigmoid colon. This condition cannot be considered pathologic in the subgastric transverse colon, since it occurs in all of the 26 cases examined. In the other portions, the redundant loops appear to be vestigial, but they may cause results which are pathologic for the individual.

Angulation and more or less kinking exist or are potential at the bases of the limbs of the loops in all of the 26 cases; and from shallowing of the gastrocolic ligament above and just medad to the splenic flexure in 2 cases (0-XL, 9-XLV).

A developmental peritoneal veil was found in 2 cases at term, covering the anterior or outer face of a fixed loop, binding together the limbs of the latter and making a secondary attachment in continuity to the adjacent postero-lateral-wall—1 in the descending colon (9-XLII) and 1 in the ascending colon (0-XL).

In 9-XLII the redundant loop is bound together by irregular adhesion of the meso, the meso being deeper in the center of the loop than at the ends of its limbs. On its outer (or anterior) surface, this loop is so covered by additional peritoneum as to make one smooth continuous surface. This peritoneum in no way differs in appearance from the normal peritoneum with which it is everywhere continuous. It passes over the entire loop (intestinal limbs as well as connecting meso), and then continues beyond to form folds above and below, these folds being attached to the postero-lateral abdominal wall. These folds also do not appear to differ from the normal, continuing peritoneum. On the inner (or posterior) side of the loop, the two limbs are connected only by the normal-appearing meso which is only a few mm. in width.

In 0-XL, a peritoneal fold which cannot be distinguished from the normal adjacent parietal and mesenteric peritoneum begins at the junction of the ascending colon with the cecum and is attached in continuity to the right postero-lateral abdominal wall, just above the lower edge of the liver, where it seems to form a sustentaculum hepatis. On this, the uppermost fixed loop and the lower edge of the liver rest as on a hammock. This fold forms a veil over the outer part of the loop immediately below, binding its limbs together.

the preceding parietal tracing in the areas belonging to the pelvic sigmoid and the subgastric transverse portions, these two divisions of the colon being found more or less redundant in all the prenatal cases. Though it must be remembered that all or a part of this redundancy (especially in the case of the subgastric transverse colon) may, for the moment, be more or less fulled-up along a line approaching the foregoing parietal attachment.

Variable Redundancy. (Plates V, VI, Fig. 6).

But in one-half of the cases studied (7 out of 14 at term, 6 out of 12 fetal cases), further modification is noted in the area of the subcystico-duodeno-pyloric transverse colon, this portion of the transverse colon being in these cases also more or less redundant.

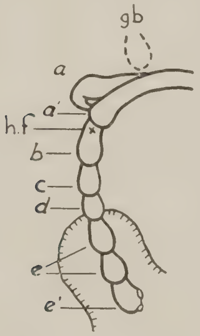

Fig. 3—Descent of the Cecum. Levels at which the Cecum is found in 26 prenatal cases (14 at term, 12 fetal cases between the 4th and 8th months)—*g b*, gall bladder; *h f*, hepatic flexure; (*a*) 5-XLIX, (*a'*) 4-XVII—there is no ascending colon, the cecum is continuous with the subhepatic transverse colon; (*b*) 5-XVI, the cecum is continuous with a very short ascending colon; (*c*) 9 cases at term, 5 fetal cases; (*d*) 2 cases at term, 2 fetal cases; (*e*) 2 cases at term, 2 fetal cases; (*e'*) 9-XXXIX, at the brim of the pelvis.

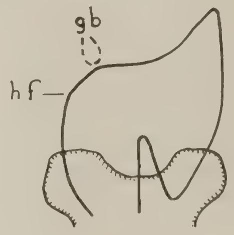

Fig. 4—Schematic Outline of the Final Parietal Attachment of the Colon—*g b*, gall bladder; *h f*, hepatic flexure.

And one-half of all cases at term (7 out of 14) show a similar modification in the ascending colon; while a little over a third of the cases in this group (5 out of 14) show a similar modification in the descending colon and in the subhepatic transverse colon.

A comparison of these observations with those made in the fetal cases seems to show that the numerical occurrence of redundancy is the same in both groups for the pelvic sigmoid, the subgastric and the subcystico-duodeno-pyloric transverse colons, and that it shows only a slight variation in the descending colon and in the subhepatic transverse colon; but that it shows a marked increase in the ascending colon in the later months of prenatal life, no redundancy being seen in this last portion of the colon till the 8th month, when it appears in both of the 2 cases at this age, while it is found in 7 of the 14 cases at term.

If made without further study this last observation might suggest that while the relative redundant tendencies of all the other portions of the colon are determined in early prenatal life, the ascending colon tends toward a disproportionate increase in length after the 7th month.

SECONDARY REDUNDANCY OF THE ASCENDING COLON; RELATION TO THE UNDESCENDED CECUM. (Plates V, VI; Figs. 3, 7).

But the ascending colon differs from all other portions of the colon in that one of its ends (the cecum) has at a certain stage of development greater powers of migration or displacement than are possessed by its other end (hepatic flexure), and as will be shown later, its migratory end is displaceable upward toward its fixed end, as well as in other directions.

In the presence of such upward migration or displacement (as for instance in 9-XXII) the ascending colon then appears redundant, with the cecum undescended.[63] But if adhesion of the meso be sufficiently delayed to permit the cecum subsequently to migrate or to be displaced downward, sufficient length of ascending colon is seen to exist to change its form to that of non-redundant, with the cecum quite able to reach the iliac fossa.

Hence, in the matter of redundancy one can not exactly compare the ascending colon with the other portions of the colon, for one must consider additional questions of cecum migration or displacement as well as of meso adhesion (ascending meso, mesocecum, terminal mesentery).[64]

It thus appears that while the relative length of the ascending colon may not always be determined at as early a period as is that of the other portions of the colon, the discrepancy is not so great as appears at first sight.

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[63] Descent of the Cecum. (Fig. 3). In 24 out of 26 cases (14 out of 14 at term, 10 out of 12 fetal cases) the cecum has begun its descent and it is found in varying positions along its course from high up under the liver (9-XXII) down to the brim of the pelvis (9-XXXIX). 1 case appears to be just over the border line (5-XVI); in this case the cecum has descended enough to be continuous with a very short ascending colon which in turn is continuous with a typical subhepatic transverse colon.

In the remaining 2 of the 26 cases the cecum has not descended but lies high up under the liver and no ascending colon is present (5-XLIX, 4-XVII). In 5-XLIX the cecum is continous with the subhepatic portion of the transverse colon, this portion having a short transverse course. In 4-XVII, the cecum has descended enough to be continuous with a typical short but redundant oblique subhepatic transverse colon.

[64] One may note that in spite of redundancy of the ascending colon the cecum lies below the crest of the ilium in 2 of the 9 redundant cases (9-XLVI, 8-XLI) and upon the crest in 2 other cases (9-XXVIII 8-XLIV); and that in all the 5 redundant cases in which it lies above the crest, it has a length sufficient to permit it to reach the crest, or sometimes to extend far below this point, should an irregularly adhering meso not prevent (0-XXVII, 0-XL, 9-XXII, 9-XXXVII, 9-XLII).

And again, that in the non-redundant cases, the cecum lies below the crest in 3 of the 17 cases (9-XXV, 9-XXXIX, 4-XXIII) and upon the crest in 2 cases (9-XLV, 7-XLVII) but that it does not reach the crest in the remaining 12 cases (4 at term, 8 fetal cases).

Two Types of Undescended Cecum. (Fig. 3, 7; Plates V, VI).

It is also evident that two types of undescended cecum occur in the 17 of the 26 cases in which the cecum is found above the crest of the right ilium:

(1) A true type of undescended cecum in which the lack of descent is essential, it being due to the development of only a length of ascending colon which is insufficient to permit of a lower position of its caudad end, the cecum. This condition is seen more or less marked in the 12 non-redundant cases in which the cecum occupies a lumbar position.[65]

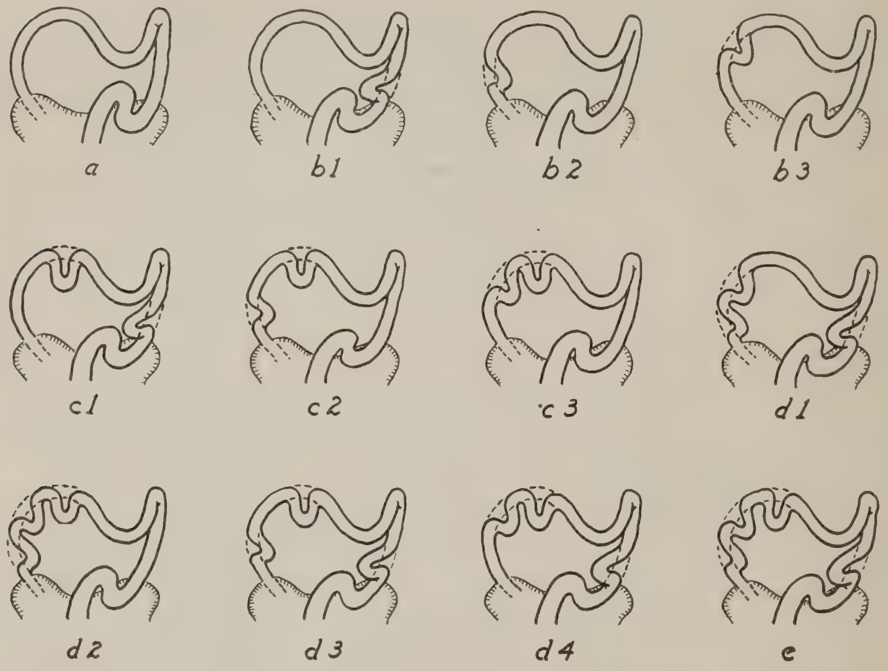

Fig. 6—Schematic Outline of Variable Redundancy of the Colon; According to the portions of colon affected and according to the number of portions—(*a*) Basic redundancy, 2 portions; (*b* 1), (*b* 2), (*b* 3), redundancy in 3 portions; (*c* 1), (*c* 2), (*c* 3), in 4 portions; (*d* 1), (*d* 2), (*d* 3), (*d* 4), in 5 portions; (*e*), in all 6 portions.

(2) An adventitious type of undescended cecum in which the lack of descent is accidental, there being already developed a length of ascending colon sufficient to permit of the cecum's reaching the crest of the ilium or even a much lower position.

But owing to migration or displacement of some part of this portion of the colon, with or without some added irregularity in mesenteric adhesion, descent of the cecum is prevented (though perhaps only temporarily) and the more distal ascending colon appears to be redundant and is thrown into one or more loops. This condition is seen more or less marked in the 5 redundant cases in which the cecum occupies a lumbar position (Fig. 7).

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[65] 9-XII, 9-XV, 9-XXXVIII, 9-XLVIII, 7-XVIII, 7-XXIV, 6-XIX, 6-XLIII, 5-XVI, 5-XXIX, 5-XLIX, 4-XVII (the ascending colon being entirely absent in 2 of these cases—5-XLIX, 4-XVII).

4 of the 9 cases in which the cecum has descended so as to lie upon or to pass the crest of the right ilium, show that in addition to a sufficient length of the ascending colon, upward migration or displacement of the cecum is also necessary for the development of type (2). In these 4 cases although irregular adhesion of the proximal ascending meso has occurred, developing redundancy and more or less fixation of loops, yet the fixation has not occurred in conjunction with upward migration or displacement of the cecum, and the latter has thus not been prevented from reaching or passing the crest of the ilium (9-XXVIII, 9-XLVI, 8-XLI, 8-XLIV).

In the remaining 5 of these 9 cases, the cecum has descended to varying points below the crest of the ilium and the ascending colon is non-redundant (9-XXV, 9-XXXIX, 9-XLV, 7-XLVII, 4-XXIII).

INDIVIDUAL OCCURRENCE OF REDUNDANCY OF THE COLON. (Plates V, VI, Fig. 6).

Individual occurrence of redundancy may be studied along two lines:
(A) According to the predominating portions of colon affected;
(B) According to the number of portions of colon involved.

(A) This has already been studied in outline at the beginning of this chapter. There it was noted that the proportion of individual occurrence of redundancy found is about the same throughout prenatal life, being greatest numerically in the pelvic sigmoid and subgastric transverse colons, next in the subcystico-duodeno-pyloric transverse colon, and next about equally in the descending and the subhepatic transverse colons. The occurrence in the ascending colon at term equals that in the subcystico-duodeno-pyloric transverse colon but it was not seen in fetal life before the 8th month.

(B) The distribution of the colon which is found common to all the prenatal cases, *i. e.*, more or less redundancy of the two portions, the pelvic sigmoid colon and the subgastric transverse colon, may as already stated be called the basic form of the colon. (Fig. 5).

This basic form is found unmodified in 8 of the 26 cases (4 at term, 4 fetal cases) (Fig. 6*a*) but it is varied by some additional redundancy in other portions of the colon in the remaining 18 cases. (Fig. 6*b*, *c*, *d*, *e*.)[66]

Individual variations of this basic form are found according as redundancy occurs in one or more additional portions of the colon. As six portions of the colon have been here studied, these variations include redundancy in from three to six portions.

More or less redundancy is found in only 2 portions of the colon (*a*), in 8 of the 26 cases (4 at term, 4 fetal cases); in 3 portions (*b*), in 3 cases (2 at term, 1 fetal case); in 4 portions (*c*), in 8 cases (4 at term, 4 fetal cases); in 5 portions (*d*), in 5 cases (2 at term, 3 fetal cases); and in all 6 portions (*e*), in 2 cases (2 at term). (Fig. 6).[66]

In seeking some guiding principle in these very varied combinations, one notes that (*a*) and (*c*), containing redundancy in 2 and 4 portions, respectively, are not only the two largest groups but that each contains the same number of cases (8), making together nearly two-thirds of the whole number of cases (16); and also that each group total (8) is made up of the same number of cases, 4 at term and 4 in fetal life.

Studying these two groups, (*a*) and (*c*), one notes that aside from the constant presence in both of redundancy in the pelvic sigmoid and the subgastric transverse colons, there is found the constant presence in (*c*) of redundancy of the subcystico-duodeno-pyloric transverse colon. But in no case is there found added to the basic form of (*a*) redundancy of only the subcystico-duodeno-pyloric transverse colon. In every case there is added redundancy of also another portion of the colon.[67]

Extending this line of investigation to the next group, (*d*), one notes in 3 of the 5 cases the constant presence of redundancy of the pelvic sigmoid, the subgastric transverse and the subcystico-duodeno-pyloric transverse colons. And in all 3 cases there is added redundancy of 2 other portions of the colon.[68]

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[66] Designating (Fig. 6) as (*a*) the basic form of constant redundancy in the two portions, he pelvic sigmoid colon and the subgastric transverse colon, the simplest individual variation from this basic form is

(*b*) Redundancy in 3 portions of the colon, one additional to the pelvic sigmoid and the subgastric transverse portions. This variation occurs in 3 cases; and these added 3rd portions are, respectively, the descending, the ascending and the subhepatic transverse colons (9-XV, 9-XXII, 4-XVII).

(*c*) Redundancy in 4 portions of the colon, two additional to the pelvic sigmoid and the subgastric transverse portions. This variation occurs in 8 cases. The 3rd added portion in all of these 8 cases is the subcystico-duodeno-pyloric transverse colon; and the 4th added portion is the descending in 4 cases (9-XLVIII, 7-XVIII, 7-XLVII, 5-XLIX), the ascending in 2 (0-XL, 9-XLVI), and the subhepatic in 2 (9-XXV, 5-XXIX).

(*d*) Redundancy in 5 portions of the colon, three additional to the pelvic sigmoid and the subgastric transverse portions. This variation occurs in 5 cases. The 3 added portions are the subhepatic transverse, the ascending and the descending in 2 of the cases (9-XLII, 8-XLI); the subcystico-duodeno-pyloric transverse, the subhepatic transverse and the ascending in 1 case (9-XXXVII); the subcystico-duodeno-pyloric transverse, the ascending and the descending in 1 case (8-XLIV); and the subcystico-duodeno-pyloric transverse, the subhepatic transverse and the descending in 1 case (6-XLIII).

(*e*) Redundancy in all 6 portions of the colon. This variation occurs in 2 cases, both at term (0-XXVII, 9-XXVIII).

[67] In 4 cases this added portion is the descending colon; in 2, it is the subhepatic transverse and in 2, it is the ascending.

[68] These 2 other portions are equally divided among the subhepatic transverse, the descending and the ascending colons. In the remaining 2 cases in this group redundancy of the subcystico-duodeno-pyloric transverse colon is absent, the 3 portions added to the basic redundancy being the subhepatic, the descending and the ascending colons.

Hence, one can only say that one may expect in all prenatal cases more or less redundancy in the pelvic sigmoid and in the subgastric transverse colons; and that to this basic redundancy one may expect to find added in about one-half of all the prenatal cases, more or less redundancy of the subcystico-duodeno-pyloric transverse colon. One may further expect a redundancy of the descending colon in less than one-half of the fetal cases and in more than one-third of those at term, of the subhepatic transverse colon in one-third of the fetal cases and in more than one-third of those at term, and of the ascending colon in one-sixth of the fetal cases and in one-half of those at term.

And as to the expectation of the number of redundant portions of the colon, one can only say that according to this study, in one-third of the fetal cases and in less than one-third of those at term one may expect to find redundant only the basic *two* portions, *i. e.*, the pelvic sigmoid and the subgastric transverse colons, and that one may expect to find *four* portions involved in the same proportion of cases, *three* portions in 1 out of 7 cases at term and 1 out of 12 fetal cases, *five* portions in 1 out of 7 cases at term and in 1 out of 4 fetal cases, while all *six* portions are found only in 1 out of 7 at term.

VARIATION IN REDUNDANCY OF THE OTHER PORTIONS OF THE COLON AS RELATED TO THE THREE TYPES OF SIGMOID COLON. (Plates V, VI; Table XI)

In studying the sigmoid colon and noting its formation of three types according to the amount of its redundancy (pp. 150-152), the question arises whether this individual variation extends also to other portions of the colon.

For instance, has the child with the least redundant sigmoid colon (1st type) also a minimum amount of redundancy in the other portions of the colon. And has the child with the most redundant sigmoid colon (3rd type) also a maximum amount of redundancy in the other portions of the colon.

Otherwise stated, is the individual colon consistently redundant throughout, or is its redundancy influenced also by localizing factors?

We see the influence of localizing factors in three instances: (1) The sigmoid colon—which acts so distinctly as a reservoir; (2) The subgastric transverse colon and (to a less extent) the subcystico-duodeno-pyloric transverse colon—the two portions of the colon which are so definitely related to that mobile organ, the stomach; and (3) The ascending colon—which has for a considerable period of time one mobile extremity (the cecum).

Such definite variations in redundancy as are noted in the pelvic sigmoid colon are not found in the subgastric transverse colon, and from this study no division into types of subgastric transverse colon can be made, but it is seen that this portion of the colon is more or less redundant in every case examined.

Studying the redundant portions of the colon additional to the pelvic sigmoid and the subgastric transverse colons, as found in the three types of sigmoid colon (Table XI), one notes in the 1st type the occurrence of 19 additional portions in the 11 cases in which details are noted, 12 in the 8 cases of the 2nd type and 11 in the 6 cases of the 3rd type.

This makes an average of $1\ {}^{8}/_{11}$ additional redundant portions in the 1st type, 1½ in the 2nd type and $1\ {}^{5}/_{6}$ in the 3rd type.

Thus, if further investigation supports the average occurrence found in this study, the percentage of chances for added redundancy would seem to be about 36% when the 3rd type of sigmoid colon is found, about 34% when the 1st type is found and about 29% when the 2nd type is found.

But it must be remembered that in all three types, cases occur in which no added redundancy is found, and that these cases are relatively more frequent in the 3rd, 2nd and 1st types, respectively.

One other interesting observation appears from a study of Table XI. While the totals in each type seem to show a slightly varied tendency to predominance in some of the added redundant portions of the colon, the grand totals show predominance to be not very pronounced but singularly co-ordinated, *i. e.*, a predominance of the subcystico-duodeno-pyloric transverse colon, the descending colon, the subhepatic transverse colon and the ascending colon as 12, 11, 10 and 9, respectively.

In connection with the constant redundancy of the subgastric transverse and the pelvic sigmoid colons, it is interesting to note that the next most constantly redundant portion of the colon is that most nearly associated postnatally with the subgastric transverse colon, *i. e.*, the subcystico-duodeno-pyloric transverse colon, while the next most constantly redundant portion of the colon is that most nearly associated prenatally with the sigmoid colon, *i. e.*, the descending colon.

Migrations and Displacements of the Proximal Colon.
(Plates V, VI)

The intrinsic migrations and displacements of the colon which is proximal to the sigmoid colon (the latter having been studied separately in an earlier chapter) are activities by which the redundant portions occupy more or less of one of two main positions, *i. e.*, (1) They are more or less gathered or fulled-up along the lines of their parietal attachments, the loops being thus more or less potential; or (2) Their major peritoneal attachments (mesos and gastrocolic and duodeno-colic ligaments) are wholly or partly unfolded and the related portions of the colon extend in U-loops downward or inward, as well as forward, in the abdomen.[69]

In addition to the above intrinsic changes of position, the U-loops show to a certain degree some of the migrations and displacements already studied in the sigmoid colon loops, *i. e.*, interchangeability, sliding and rotations.

By interchangeability the loops may be changed relatively, one loop or part of a loop increasing or decreasing at the expense of the movable continuing portion of the colon. This form of activity seems to be related to the process of gathering or fulling-up and it is best seen in the subgastric transverse colon; the loops here are larger and even when secondary fixation is present they offer a better field for its demonstration.

Still it was not seen in the yet larger loops of the descending colon, so some factor other than depth is concerned; the suggestion is that beyond a certain point both distal resistance and distension tend to inhibit it.

Interchangeability is more limited in the other portions of this more proximal colon.

The subcystico-duodeno-pyloric transverse colon is never of very great extent, even when redundant both of its extremities tend to be fixed, and in the redundant cases the adhesion of the major peritoneal folds tends toward an irregularity which leads to secondary fixation—all of these conditions interfering with interchangeability.

The subhepatic transverse colon is of even less extent, thus bringing its two fixed extremities still closer together. But interchangeability tends to act throughout the whole of its extent, since secondary fixation was found in only 2 of the 9 redundant cases.

In the ascending colon the action of interchangeability is usually very limited because the loops are usually small and because of secondary fixations, but this form of activity seems to have a more extended field in 2 cases in which the ascending meso and the mesocecum are continuous (9-XXVIII, 9-XLII) and in a 3rd case (9-XXII), in which both of the preceding mesos and also the terminal mesentery are continuous.

This portion of the colon may lie in a smaller or larger S in the right lateral abdomen. Then the meso of the loops may be wholly or partly unfolded and the loops interchange so that a U-loop falls obliquely downward and inward (and perhaps forward) in the abdomen (9-XLVI), or the loop may even be thrown upward across the hepatic flexure (8-XLIV).[70]

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[69] The subgastric transverse colon loops were found potential in 8 of the 26 redundant cases (5 at term, 3 fetal cases); those of the subcystico-duodeno-pyloric transverse colon in 2 of the 13 redundant cases (2 at term); those of the subhepatic transverse colon in 3 of the 9 (2 at term, 1 fetal case); of the ascending colon in 2 of the 9 (2 at term); and of the descending colon in 1 of the 11 (1 fetal case). In all the other redundant cases the loops were found wholly or partly unfolded.

Only 2 cases had the loops potential in all 5 portions of this more proximal colon (9-XXVIII, 9-XXXVII), and in the latter of these the redundancy formed small fixed ripples in the subhepatic transverse and the ascending colons. Similar fixed ripples occurred in the subhepatic transverse colon in 1 other case (4-XVII).

Sliding is a constant feature of the transition from the potential to the actual loops.

Rotations may occur upon an antero-posterior or a transverse[71] axis, or upon such a combination of these as to suggest an oblique axis, but a very marked degree of any form of rotation was not found in the descending, the subgastric transverse, or the subcystico-duodeno-pyloric transverse colons.

In the descending colon, the above rotations resulted in such a swing of the loop upon its fixed base as to make the horizontal U's tend to point forward, and perhaps a little downward, as well as inward.

The predominant rotation found in the subhepatic transverse colon was upon a transverse axis, so that the loop tended to be directed obliquely downward and inward, or upward and outward.[72]

In the ascending colon, the predominant rotation found was upon an axis which was transverse (or a little oblique to the transverse), so that the loop tended to be directed inward or outward, and perhaps downward, and perhaps also forward, in the abdomen, making a horizontal or oblique U. These have been already enumerated.

Rotation to a slight extent upon a longitudinal axis is occasionally seen, either alone (8-XLIV) or in combination with the preceding (9-XLII), resulting in the limbs of the loop tending to lie superimposed from before backward. In 8-XLIV the whole ascending colon rotates so that it is found arched, with the convexity of the arch forward.

Migrations and displacements of the cecum seem to depend upon the inter-related depths of the mesocecum, the ascending meso and the terminal mesentery (*q. v.*). Under favoring conditions the movements of this viscus may describe a rather extensive radius, so that it may move upward and inward to the level of the umbilicus, midway between the latter and the right lateral wall of the abdomen (9-XXII), or downward and outward to above the crest of the ilium in the anterior axillary line (9-XLII), to just beneath the antero-lateral abdominal wall (0-XL) or to the outer side of the kidney (9-XXXVII). As it moves, it and the small intestines interchange positions and it may lie among the latter, or beneath them or upon them just beneath the abdominal wall (9-XLVIII)—thus lying in relation with a changing elastic cushion which tends to mask its limits and the density of its contents. Or, though having a deep meso, it may for the moment be hidden beneath the right lobe of the liver (9-XXII).[73]

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[70] Or if the meso is only partly unfolded this portion of the colon may lie in a larger S-shaped coil, the two horizontal, vertical or oblique U's of the S having their bases in opposite directions (9-XXII, 9-XLII). Experiment shows these larger S formations may, like the smaller ones, be further converted into 1 U-loop, or a U-loop may itself become deepened, provided the meso is free and of sufficient depth.

[71]. Owing to the yielding nature of the anterior abdominal wall and the relatively more resistant nature of the posterior abdominal wall, more or less forward or forward and cephalad, and the reverse movement, (due to more or less rotation on a transverse axis) is probably continually occurring, separately or in conjunction with the other movements described. And all stages of forward or forward and upward rotation of these U-loops upon their transverse axes have been observed or have been produced experimentally (Section III).

[72]. In the former case, it forms an oblique U extending downward, inward and forward in the abdomen (6-XLIII); in the latter case, it forms an oblique inverted-U, tending to make a rounded right angle close up under the liver (8-XLI, 5-XXIX). If to this latter position be added rotation to the left upon an antero-posterior axis, a vertical inverted U-loop will be formed (9-XXV).

These movements seem to be due to sliding and to rotation upon antero-posterior and transverse axes. Rotation upon a longitudinal axis is also observed. This may be forward, resulting in displacement forward of the appendix and terminal ileum (5-XLIX); or forward and inward, resulting in displacement of the appendix and terminal ileum more or less backward (4-XVII); or forward and outward, resulting in displacement of the appendix to the outer side (9-XXVIII, 9-XLVIII).

These observations suggest how similar, or other, migrations and displacements of the cecum during the periods when meso adhesions are occurring, may explain some of the fixations of the appendix in its well-known anomalous locations, the appendix being for some time merely the termination of the cecum, and being at all times an anatomic part of the cecum and sharing more or less in the movements of the latter.

Such cases have been usually described as examples of non-rotation of the cecum and have been considered as a persistence of an early fetal stage. But the observations made in this study regarding mobility of the different portions of the intestine must raise a question as to the constant accuracy of such a conclusion. May it not be that sometimes the one and sometimes the other process may explain the anatomic finding?[74]

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[73] In 16 out of 26 cases (9 out of 14 at term, 7 out of 12 fetal cases) the cecum lies in whole or in part upon the right kidney (in 9-XXVIII and 7-XLVII it lies partly on the kidney and partly on the ilium).

In 5 cases (2 at term, 3 fetal cases) it lies in whole or in part upon the posterior abdominal wall (in 9-XLV and 8-XLIV also upon the crest of the ilium).

In the remaining 5 cases (3 at term, 2 fetal cases) it lies in the iliac fossa (in 9-XXXIX as low as the brim of the pelvis).

[74] In 9-XXVIII and 9-XLVIII the U-shaped infundibuliform cecum has apparently rotated outward on a longitudinal axis, so that its distal funnel-like limb (which is continued onward as the appendix) lies to the outer (right) side of its proximal limb, this latter continuing the line of the ascending colon. As a result the appendix is directed to the outside of the ascending colon—upward and backward under the liver in the former case, and up over the middle of the kidney to the junction of the kidney and the liver, in the latter case.

In 5-XLIX and 4-XVII, the cecum is very evidently nearing the completion of the developmental rotation appropriate to the age of the child; in both cases the ileum enters the cecum from before backward. In 5-XXIX, this rotation is more advanced and in 4-XXIII it is practically completed.

In 4-XVII the cecum has apparently undergone a double rotation—inward on a longitudinal axis and upward on a transverse axis. As a result, its external surface is directed upward toward the liver, and the ileum is directed downward toward the crest of the ilium. The appendix is also directed downward.

Extrinsic migrations and displacements of the subgastric and the subcystico-duodeno-pyloric transverse colons are those movements which are related to migrations and displacements of the stomach and the movable part of the 1st portion of the duodenum, to which viscera these portions of the colon are attached by the gastro-duodeno-colic ligament.

These movements consist of a swinging of the related colon forward and perhaps to the right as the stomach is distended, and a return swing to the left and backward as the stomach becomes emptied. The range of movement is governed largely by the degree of distension of the stomach; it is also affected by the depth of the gastro-duodeno-colic ligament and by the amount of redundancy of the related colon. These factors are studied in detail in a later chapter (Section III).

DEVELOPMENTALLY FIXED LOOPS OF THE COLON. (Plates V, VI; Figs. 6, 7, 9; Table XI)

IDENTIFICATION OF COLON LOOPS.

Viewing the colon as a whole, individuality of the fixed loops seems to be a prominent feature.

This is due to the tendency of the different portions of the colon to become fixed at least at their beginnings and terminations, by decrease in meso depth, with or without other factors.

The points of fixation are:

(1) The neighborhood of the 3rd sacral vertebra;
(2) Left psoas muscle at the brim of the pelvis;
(3) Crest of the left ilium;
(4) Splenic flexure;
(5) Neighborhood of the middle of the antrum of the stomach;
(6) Below the gall bladder;
(7) Hepatic flexure;
(8) Caudad end of ascending meso and ileal end of the mesentery.

With remembrance of these points, identification of the fixed loops should not be difficult, since with two exceptions the loops are formed between, and not at, the points of fixation. The two exceptions are the midantrum (5) and below the gall bladder (6).[75]

Thus, the inverted-U fixed loop in the extreme right upper abdomen in 9-XXV must belong to the subhepatic transverse colon, since it lies between the gall bladder and the hepatic flexure.

But the inverted-U which lies in the same location in 8-XLIV, and which looks like the one in 9-XXV, merely rotated forward and inward on a longitudinal axis, belongs to the ascending colon since it lies proximal to the hepatic flexure.[76]

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[75] In 9 of the 26 cases (3 at term, 6 fetal cases) the fixed loop has its right limb attached to the right of the midantrum, so that the loop hangs more or less below this latter point; 0-XXVII, 0-XL, 9-XXV—the median loop, 8-XLIV, 7-XVIII—the median loop, 7-XLVII—the right loop, 6-XLIII, 5-XXIX, 5-XLIX.

In 3 of the 26 cases (2 at term 1 fetal case) the fixed loop hangs below the gall bladder; 9-XXV—the right loop, 9-XLVI, 7-XLVII. In the last case it hangs also more or less below the last portion of the duodenum.

This method of identification is especially necessary in a case like 9-XLVI where in the upper right abdomen it shows the vertical external fixed U-loop to belong to the ascending colon, while the immediately adjoining internal loop belongs to the subscystico-duodeno-pyloric transverse colon. This latter loop lies immediately below the gall bladder, the subhepatic transverse colon being very short and lying almost vertical above the hepatic flexure.

Identification of the loops in the subcystico-duodeno-pyloric and the subgastric transverse colons is simpler, since the relation of the loops to the gall bladder, to the 1st portion of the duodenum, and to the pylorus, antrum and body of the stomach are more readily apparent.

The loops of the descending colon when traced to their left lateral bases present no difficulties except in a rare case like 9-XLVIII where descending, iliac sigmoid and pelvic sigmoid mesos are all delayed in adhesion.

The pelvic sigmoid colon as here studied has no secondary loops developmentally fixed, all its loops being resolvable into the one primary fixed loop formed by this portion of the colon as a whole.

LOCATION IN THE ABDOMEN OF FIXED LOOPS. (Plates V, VI).

Again viewing the colon as a whole, one notes the predominance of the largest fixed loops in the left abdomen, those of more medium size in the more median or median and right abdomen, and those of perhaps still smaller size in the extreme right abdomen, either upper or lateral—though some of both the deepest and the shallowest loops occur in the left lateral abdomen (descending colon).[77]

One notes the tendency of the fixed loops of the colon to occupy rather definite positions, so that one may be inclined to draw quite arbitrary deductions. As has been noted above, further study shows errors that tend to follow such deductions, especially regarding loops lying in the upper right abdomen and in the left and median, median and right, and left, median and right abdomen.

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[76] And the extreme upper horizontal-U in the same location in 0-XL, is made by both of the preceding portions of the colon, since the hepatic flexure forms the rounded angle of the loop whose apex is directed outward. Hence in this case all the fixed loops below this one belong to the ascending colon alone.

In 0-XXVII and 9-XLII the landmarks of divisional fixation again identify the lower loops in this same region as belonging to the ascending colon, and the upper to the subhepatic transverse colon—these latter including both horizontal-U loops (one with base directed outward and one with base directed inward) since both are found not only distal to the hepatic flexure but also proximal to the gall bladder.

[77] It will be remembered that the maximum depth of the loops noted from left to right, *i. e.*, in the subgastric, the subcystico-duodeno-pyloric and the subhepatic transverse colons, and the ascending colon, at term and in the fetal cases, are, respectively, 45 and 45 mm., 28 and 15 mm., 18 and 12 mm., and 15 and 12 mm. While the maximum depth of the loops in the descending colon in the two groups, varies as 65 and 15 mm.

We have seen that loops in the last three of these regions are or may be formed by the subcystico-duodeno-pyloric and the subgastric transverse colons, and in varying proportions. We have also seen that the location of such loops may vary with the degree of emptiness or distension of the stomach, but this phase can be studied more advantageously in connection with this latter viscus.[78]

INDIVIDUAL OCCURRENCE OF FIXED LOOPS.

In the preceding paragraphs we have studied the individual occurrence of redundancy, which is so closely related to the individual occurrence of fixed loops.

An attempt is made in Table XI to indicate this latter, both numerically and graphically. Repeating that in the sigmoid colon no developmentally fixed loops were found other than the loop formed by the pelvic sigmoid colon as a whole, we note that every other portion of the colon does show the occurrence of developmentally fixed loops, with greater or less individual variation.

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[78] For the present (omitting the sigmoid colon which has already been studied in detail), one notes that in general terms fixed loops in the

left lateral abdomen—belong to the descending colon. These are more or less horizontal U's with bases directed inward. The loops are directed inward and perhaps also forward and downward (9 out of 26 cases):

left abdomen—the subgastric transverse colon alone. These are vertical U's, though perhaps sometimes a little oblique to either left or right (19 out of 26 cases). When the stomach is distended these loops may extend more or less to the right of this position:

left and median abdomen—if horizontal U's with bases inward, the descending colon (3 out of 26 cases 0-XXVII. 9-XV 9-XLVIII): if vertical U's may be the subgastric transverse colon alone; or may be combination of the subgastric and more or less of the subcystico-duodeno-pyloric transverse colons (5 out of 26 cases—7-XVIII, 7-XLVII, 6-XLIII, 5-XXIX, 5-XLIX):

median abdomen—vertical U's, subcystico-duodeno-pyloric transverse colon alone (1 out of 26 cases 9-XLVIII): in this location, the loop is most apt to be subpyloric:

median and right abdomen—vertical U's, combination of subgastric and subcystico-duodeno-pyloric transverse colons (1 out of 26 cases—9-XXV):

left, median and right abdomen—vertical U's which may be more or less elliptical in shape, combination of subgastric and subcystico-dyodeno-pyloric transverse colons (3 out of 26 cases—0-XXVII, 0-XL, 8-XLIV):

right abdomen—vertical U's, subcystico-duodeno-pyloric transverse colon alone (6 out of 26 cases); in this location, the loops are more apt to be subcystic or subduodenal than subpyloric:

extreme right upper abdomen—vertical, oblique or inverted-U loops, subhepatic transverse colon alone (9 out of 26 cases);

horizontal U's with base outward—combination of subhepatic transverse and ascending colons, with hepatic flexure forming outward-directed base (1 out of 26 cases—0-XL);

vertical inverted-U—ascending colon alone (1 out of 26 cases—8-XLIV);

right lateral abdomen—horizontal or oblique U's, directed inward or outward, also downward or upward, and perhaps forward—ascending colon alone (8 out of 26 cases).

These loops occur most often in the subgastric transverse colon (14 out of 14 at term, 12 out of 12 fetal cases), and least often at term in the subhepatic transverse colon, the subcystico-duodeno-pyloric transverse colon alone and the descending colon (5 out of 14 cases), and least often in the fetal cases in the ascending colon and the subcystico-duodeno-pyloric transverse colon alone (2 out of 12 cases).

The individual combinations of the different portions of the colon which are found have already been summarized under Individual Occurrence of Redundancy.

Angulation, Kinking and Torsion—With Special Reference to Mechanical Obstruction and Stasis; Spontaneous Compensation. (Plates V, VI; Figs. 7, 8, 9; Table XI)

The tendency to mechanical obstruction must be always present, and stasis is always potential, at the bases of one or both limbs of unfolded fixed U-loops, since this unfolding moves toward producing or increasing angulation.

Irregular diminution in depth of the mesos (or other related peritoneal folds) of a redundant intestine helps to form the angulations and it also fixes them. The fixation diminishes the power of interchangeability—and our studies of the sigmoid colon have shown how this latter form of activity is able to modify, or move, or even to remove, angulation. Similar results are seen in this more proximal colon as the result of the form of interchangeability called gathering or fulling-up of the loops. Hence, the gathering or fulling-up of the loops results in a form of spontaneous compensation which reduces or removes the angulations and the consequent obstruction and stasis.

The same condition of fixed angulation and unfolding of loops must also cause mechanical obstruction to the movement of antiperistalsis which may involve the angles formed at the bases of one or both of the limbs of loops.

When a U-loop is fixed at the bases of both limbs, impediment to the advancing fecal current, other things being equal, is mechanically less likely to occur at the base of the proximal limb than at the base of the distal limb. On the other hand, impediment to the backward movement of the fecal current (as by antiperistalsis or as a result of a damming backward from distal obstruction) is less marked, other things being equal, at the base of the distal limb than at the base of the proximal limb (Fig. 8).

Secondary stasis and mechanical obstruction have been seen to develop in this more proximal colon from a primary mechanical obstruction and stasis in the more distal colon—as in the overdistension of the descending and transverse colons following overdistension of the sigmoid colon (Table X), or even following prolonged angulation at the junction of the iliac and pelvic sigmoid colons at the brim of the pelvis.

The results of the mechanical processes above enumerated are observed throughout the colon, variations appearing in correspondence with the local anatomic variations in each portion. The variations in the sigmoid colon have been studied in a previous chapter.

In the descending colon—secondary stasis from distension of the sigmoid colon has been observed in 8 out of 14 cases at term and in 1 out of 13 fetal cases (Table X). In this portion of the colon it is to be remembered that mechanical impediment to the movement of antiperistalsis is always present at the splenic flexure; this impediment being due not only to the fixed angulation occurring at this point but also to the internal reduction in the colon lumen which occurs there.

In the subgastric transverse colon—one may look in three areas for possible mechanical impediment to the fecal circulation.

(1) Angulation at the left extremity—the splenic flexure. This is practically always present in greater or less degree. This angulation may become more acute when the left extremity of the subgastric transverse colon is also the left limb of an unfolded U-loop. Varying degrees of this modification are seen in 8 of the 14 cases at term and in 7 of the 12 fetal cases.

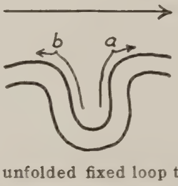

Fig. 8—Other things being equal, an unfolded fixed loop tends to offer increased resistance to the advancing fecal current at (*a*), and to the backward current (antiperistalsis) at(*b*).

Other variations in the acuteness of this angulation are possible according to (a) variation in the location of the splenic flexure; (b) variation in the height of attachment to the body of the stomach of the left extremity of the gastrocolic ligament; (c) variation in the depth of the left extremity of the gastrocolic ligament; and (d) variation in the position of the stomach as modified by a state of emptiness or distension.

Thus, other things being equal, when the stomach is empty and the greater curvature of its body is directed largely to the left, the subgastric transverse colon tends to descend along the lower part of the external border of the body of the stomach, the lower border of the body, and the line of the antrum. This line of descent is more or less regularly marked according to height of attachment of the transverse colon along the external border of the body of the stomach, according to the degree of diminution or increase in the depth of the corresponding transverse meso and gastrocolic ligament, or according to the degree to which these major peritoneal folds are folded up on themselves towards the greater curvature of the stomach.

When the gastrocolic ligament is short and is attached to the greater curvature above the level of the splenic flexure, the subgastric transverse colon may rise above the splenic flexure, then a more or less acute secondary angle (opening downward and perhaps also outward) may be formed at the point above the splenic flexure where the colon is attached closely to the external border of the body of the stomach, and where it begins its descent along the latter. This is well shown in 1 case at term (0-XL) in which the subgastric transverse colon ascends as high as the 5th interspace, in the anterior axillary line, then bending acutely on itself, it passes downward and outward to the splenic flexure. In this case, the gastrocolic ligament to the left of the junction of the middle and distal thirds of the greater curvature of the stomach has decreased almost to the point of disappearance.

But when the gastrocolic ligament is deep enough, the subgastric transverse colon runs predominantly downward and to the right from the splenic flexure without forming the secondary angulation, regardless of disproportionate heights of the attachment of the gastrocolic ligament and the position of the splenic flexure. This is well shown in 1 case (5-XLIX) in which the subgastric transverse colon runs downward and to the right from the splenic flexure. When the redundant transverse colon is gently fulled along its attachment to the gastrocolic ligament, the colon mounts along the greater curvature of the stomach to the 7th rib posteriorly, while the splenic flexure lies in the 10th space posteriorly.

When the stomach is distended and the greater curvature is directed more downward and forward, this initial ascent of the transverse colon is decreased or absent, even when the gastrocolic ligament is very short. Hence, other things being equal, the acuteness of the secondary angulation of the transverse colon in this region is diminished when the stomach is distended, and is increased when the stomach is empty. This is well shown in 1 case (9-XLV) in which the stomach is slightly distended and the transverse colon ascends above the level of the splenic flexure, and then descends; when the distension is removed and the stomach assumes its empty position, the secondary angulation to the right of the splenic flexure is increased.

The degree of shortening of the gastrocolic ligament may not be marked enough to produce the secondary angle above and to the right of the splenic flexure but only enough to hold the colon to or near the level of the flexure for a variable distance to the right of this latter. In such cases the angulation at the splenic flexure itself is decreased but a secondary angulation may be added to the right of the flexure, at the base of the left limb of the subgastric loop.[79]

Similar variations in angulation at the splenic flexure tend to occur when the loops of this portion of the colon return more or less to their fulled-up position below the greater curvature of the stomach, mechanical obstruction from this condition being least when this portion of the colon is entirely fulled-up—found in 5 of the 14 cases at term and in 3 of the12 fetal cases.

(2) Angulation at the right extremity—below the proximal portion of the antrum of the stomach, or the region to the right or left of this where the right limb of the subgastric transverse colon loop becomes more or less fixed by decreased depth of the transverse meso and gastrocolic ligament.

(a) The right limb of a subgastric transverse colon loop has its base fixed below the proximal portion of the antrum in 5 out of 14 cases at term and in 5 out of 12 fetal cases.

(b) It has its base fixed below the left end of this region, *i. e.*, at or near the antrum-body junction, in 6 out of 14 cases at term and in 2 out of 12 fetal cases.

Thus in the above 18 of the 26 cases there tends to be in the neighborhood of the proximal portion of the antrum a mechanical obstacle to the backward movement of the fecal current, already delayed in its onward movement by the splenic flexure. As this subantral fixation of the loop offers in itself no special impediment to the advancing fecal current, stasis in the subgastric loop would seem to be frequently potential.

In 4 cases, however, there is here added a mechanical impediment to the advancing fecal current in that the subantral fixation of the right limb of the subgastric loop is more or less close to the fixation of the left limb of a more median or right loop (9-XXV, 9-XLVIII, 7-XVIII, 7-XLVII). In such cases, obstruction and stasis in the subcystico-duodeno-pyloric transverse colon might tend to occur, or to make itself felt, a little in advance of that in the subgastric loop (compare with absence of such subcystico-duodeno-pyloric transverse colon loop in 9-XXII, 9-XXXIX, 9-XLII, 8-XLI).

(c) It has its base fixed at varying distances to the right of the proximal antrum in 3 of the 14 cases at term and in 5 of the 12 fetal cases. In 1 it is just to the left of the pylorus, in 3 it is just below the pylorus, in 4 it is more or less to the right of the pylorus—in 2 of these as far to the right as the gall bladder.

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[79] This is shown in 0-XL, 9-XLVI, 7-XLVII, in which cases the gastrocolic ligament decreases in depth, at first rapidly from the left limb of the loop; it then continues at this shallow depth or still further decreases as the splenic flexure is approached.

When the decrease in depth takes place gradually the left limb of the subgastric loop tends to rise to the splenic flexure itself, the acuteness of the angle at the flexure increasing in proportion to the slowness of the diminution in depth. Compare the preceding cases with 9-XXII, 9-XXV, 9-XXXVIII and others, in which the left limb of the loop rises to the splenic flexure instead of to the right of the latter.

Thus in these cases the loop is formed with the aid of more or less of the subcystico-duodeno-pyloric transverse colon, and the backward pressure passes to the subpyloric portion of the colon perhaps more directly than in the (a) and (b) groups.

(3) Angulation between the right and left extremities—secondary or minor fixed angulations in the course of the subgastric transverse colon. These are caused by intermediate irregularities in the adhesion of the major peritoneal folds (transverse meso and gastrocolic ligament).

(a) A fixed secondary loop is produced by subdivision of the primary loop (9-XXV, 9-XXXVII, 7-XVIII).

(b) Minor fixed angulations are caused by such variations in the adhesion of the major peritoneal folds as to cause more or less fixed, small, indefinite, rippling coils of the tube, too shallow in depth or too uncertain in definition to be called loops. This form of variation was found most often to the left of the loop below the body of the stomach, *i. e.*, more immediately to the right of the splenic flexure (0-XL, 9-XLVI, 8-XLI, 7-XLVII). It was found to the right of the subgastric loop in 1 case (9-XLV).

In the subcystico-duodeno-pyloric transverse colon—one may look in three areas for possible impediment to the fecal circulation.

(1) Angulation at the left extremity—below the pyloric antrum, or just to the right of this region.

(a) Such angulation may be due to the fixation of the right limb of a subgastric loop into the formation of which more or less of the subcystico-duodeno-pyloric transverse colon thus enters (9-XXV, 7-XVIII, 7-XLVII, 6-XLIII, 5-XXIX, 5-XLIX). This angulation tends to impede the action of antiperistalsis in the subgastric loop, the advancing fecal current in the subcystico-duodeno-pyloric transverse colon being hindered only secondarily to the development of stasis in the subgastric colon.

(b) The angulation may be due to the fixation in this region of the left limb of a loop formed by the subcystico-duodeno-pyloric transverse colon alone (9-XXVIII, 7-XVIII, 7-XLVII). This angulation tends to impede the advancing fecal current, thus affecting this portion of the colon primarily.

(c) The angulation may be entirely limited to this region, the loop having one limb fixed on each side of the pylorus in 1 case (9-XLVIII). Here the obstruction and stasis are primarily sharply localized below the pylorus, with secondary back pressure into the more proximal part of this portion of the colon.

(2) Angulation at the right extremity—below the gall bladder.

The more or less rounded angle opening downward and inward which predominantly marks the right extremity of the subcystico-duodeno-pyloric transverse colon below the gall bladder, may or may not be a factor in slowing the progress of the intestinal contents. But in 6 of the 14 cases at term and in 2 of the 12 fetal cases, the neighborhood of this right extremity is marked by the presence of a fixed loop of which at least the right limb is attached to the gall bladder, through the cystico-colic ligament or an analogous peritoneal fold derived from the lesser omentum—3 cases having the loop definitely fixed below the gall bladder.

The fixation of the right limb of a loop below the gall bladder tends to impede at this point the movement of antiperistalsis; the fixation of both limbs sharply localizes both obstruction and stasis (Fig. 8) below the gall bladder, with secondary back pressure into the adjoining proximal colon.

(3) Angulation between the right and left extremities.—The course of the subcystico-duodeno-pyloric transverse colon may be marked by secondary fixed angulations, these being additional factors in causing impediment to the passage of the fecal contents.

Fixed secondary U-loops are produced by subdivision of the primary loop which is considered as extending between the gall bladder and the midantrum, these secondary loops being formed by irregular adhesion of the major peritoneal folds (transverse meso and gastroduodeno-colic ligament) of a redundant subcystico-duodeno-pyloric transverse colon. As the right extremity is below the gall bladder and the left is below the pyloric antrum, the colon between these two extremities lies below the 1st portion of the duodenum.

An angle is formed in this portion of the colon by the attachment of one limb of a loop in 4 out of 14 cases at term and 3 out of 12 fetal cases. This angle is formed by the left or distal limb of a loop, thus making towards direct impediment to the advancing fecal current below the 1st portion of the duodenum, in 3 cases (9-XXVIII, 9-XXXVII, 7-XLVII). And it is formed by the right or proximal limb of a loop, thus making towards impediment to antiperistalsis below the 1st portion of the duodenum, in 4 cases (9-XXV, 9-XLVIII, 8-XLIV, 6-XLIII).

The angle occurs just to the right of the pylorus in 5 cases; it occurs further to the right in 1 case; and just to the left of the gall bladder in 1 case.

In the subhepatic transverse colon—the predominant rounding or obtuseness of the angles formed by the continuation of the subhepatic transverse colon with the subcystico-duodeno-pyloric transverse colon (below the gall bladder) and with the ascending colon (at the hepatic flexure), offers a minimum amount of mechanical obstruction to the ascent of the fecal current in its onward progress, and it offers still less resistance to an antiperistaltic movement in this region.

Two factors tend specially to change these conditions. The more important of these factors is the transformation of the above distal and proximal angles from obtuse to acute, the tendency to mechanical obstruction and stasis increasing in proportion to the increase in acuteness.

These angles become acute as the loop tends to unfold and to fall downward, inward and forward. Such position was found fully developed in only 1 case but it is potential in all redundant cases and its potentiality and importance have been developed experimetally in Section III.

When such angulation occurs, mechanical obstruction and stasis occur in a very marked degree for two reasons: (1) As the length of the parietal attachment of the meso for this portion of the colon is very short, one angle tends to supervene upon the other in a very short space; and (2) as these angles are fixed, interchangeability is impaired and is unable to overcome or to move along the angulation, as it has been shown to do in the sigmoid colon.

As the parietal attachment of the subhepatic transverse colon is so short, the extension downward of the loop tends to produce angulation at both extremities practically simultaneously, hence this position tends also to affect both the ascending colon and the subcystico-duodeno-pyloric transverse colon at the same time. The ascending colon suffers backward pressure directed against its advancing fecal current, while the subcystico-duodeno-pyloric transverse colon suffers opposition to its antiperistaltic movement. In the subhepatic transverse colon loop itself, both advancing movement and antiperistalsis meet with opposition, and this combination makes for increased local stasis.

And one must note that the advancing movement from the ascending colon is still further opposed in cases in which the distal angle of this portion of the colon is soon followed by a subcystico-duodeno-pyloric transverse colon loop, especially when this latter loop occurs below or near the gall bladder (0-XXVII, 9-XXV, 9-XXVIII, 9-XXXVII).

While one must equally note that the movement of antiperistalsis in the subhepatic transverse colon is still further opposed in cases in which the proximal angle of this portion of the colon is preceded by a condition of stasis in the ascending colon (*q. v.*).

The less important factor spoken of above in developing mechanical obstruction or stasis in this portion of the colon is irregularity in the adhesion of the transverse meso in this region so that this portion of the colon lies in small fixed loops or ripples (9-XXXVII, 4-XVII).

In the ascending colon—the predominant rounding of the angle, or the absence of a definite angulation, at the continuation of the ascending colon with the subhepatic transverse colon (at the hepatic flexure), offers a minimum amount of mechanical obstruction to the ascent of the fecal current in its onward progress, and it offers still less resistance to an antiperistaltic movement at this point.

But the situation may be transformed by increasing acuteness of the angle developing (from the side of either the ascending or the subhepatic transverse colons, or from both) as a loop unfolds and falls inward and downward.[80]

In this study, excluding the 1 case of fixed acute angle formed by both the subhepatic and the ascending colons (0-XL) and the 2 cases in which loops are here formed by both these portions of the colon (9-XXVIII, 9-XLII), angulation at the hepatic flexure as the result of redundancy is more likely to be caused by the subhepatic transverse colon alone (5 cases) than by the ascending colon alone (2 cases).

But conditions favoring mechanical obstruction and stasis in the redundant ascending colon are marked features proximal to the hepatic flexure.

The striking feature of the redundant ascending colon is its tendency to reverse its course after running upward and inward, or outward, for a short course, thus forming loops and arranging itself in some variety of S-shape (8 of the 9 redundant cases).

The tendency of these U and S formations is to be more or less fixed, owing to irregularity in the line of adhesion of the ascending meso. Of the two extremities of this portion of the colon the distal one is always fixed at the hepatic flexure, while the proximal one is continued into the cecum, the latter being more or less fixed by the mesocecum the adhesion of which is predominantly incomplete.

While the loops of the ascending colon are not deep in measurement (predominant depth 10 mm., maximum depth 15 mm.), they are relatively deep, since the length of the ascending colon is relatively short, it having its beginning in the lumbar region in 19 of the 24 differentiated cases.

The loop arrangement of the redundant ascending colon as well as the irregular adhesion of its meso tend to cause mechanical obstruction to the advancing fecal current and to favor stasis of the intestinal contents, this stasis moving towards eventual backward pressure upon the cecum, reflux beyond this latter region being opposed by the ileco-cecal valve.

But that accumulating backward pressure may cause incompetence of this valve and permit the passage of feces into the ileum is suggested by the observation that meconium was found in the ileum in 3 of the 9 redundant cases and in 2 other cases—1 in which the whole colon is reduced in calibre (5-XI) and 1 in which no ascending colon has been developed, the cecum being directly continuous with a typical subhepatic transverse colon (4-XVII).

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80. Such transformation is potential on the part of the subhepatic transverse colon in 6 of the 8 cases of redundant subhepatic transverse colon in which an ascending colon exists (0-XXVII, 9-XXV, 9-XXVIII, 9-XLII, 8-XLI, 5-XXIX) and it was found developed in 1 other case (6-XLIII).

In 1 of the 6 cases in which a subhepatic transverse colon loop is potential (9-XXVIII) a similar loop is potential in the ascending colon. An ascending colon loop is also potential at this point in 1 case in which the subhepatic transverse colon is not redundant (8-XLIV) and one is present in 1 similar case (9-XLVI) and in one other case (9-XLII).

The tendency to fixation of the ascending colon loops must offer resistance also to antiperistalsis, but this movement from more distal parts of the colon already tends, especially in the redundant cases, to be markedly opposed at the hepatic flexure. Perhaps this explains why the ascending colon is not noted as sharing in the very marked distension of the rest of the colon noted in the 11 cases in Table X.

The tendency to kinking at the bases of one or both limbs of the U-loops is emphasized in 1 case (0-XL) by the binding together of the limbs of the loop by a developmental peritoneal veil.

In the cecum—there was no evidence of stasis observed in this study unless the possible reflux into the ileum in the cases above noted may be considered as indicating such tendency. In the 3 cases at term there is over-distension of the distal colon, with evident damming back of the meconium into more proximal portions of the canal. Of the 2 fetal cases, the whole colon is diminished in calibre in 1 case and in extent in the other case the ascending colon being absent.[81]

In the absence of reflux into the ileum, cecal stasis would seem to be the ultimate end result toward which must move all conditions which hinder the onward progression of the fecal circulation, as well as all conditions which unduly favor the reverse movements of damming back and of antiperistalsis. The anatomic conditions observed in this study which tend to impede the onward fecal movement and to favor the reverse movement, have already been noted all the way from the sigmoid to the ascending colons.

Torsion was not seen in the loops in any portion of the colon proximal to the pelvic sigmoid colon. The only suggestion of such movement is the slight rotation by which the originally horizontal loops of the descending and ascending colons tend to be directed downward and forward, as well as inward—or sometimes outward in the case of the ascending colon.

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[81] In 0-XXVII in which there is distension and apparent damming back of meconium in the sigmoid, the descending, and the subgastric transverse colons, the jejunum as well as the ileum is distended, the latter with meconium and the former with gas.

In 0-XL, in which there is distension of the sigmoid, the descending and all of the transverse colons, the ileum is distended with meconium and gas while the jejunum is empty and flattened.

In 9-XXXVII, in which there is distension of the sigmoid colon and the lower part of the descending colon, the ileum contains meconium and the 1st and 2nd portions of the duodenum are dilated to the usual size of the proximal colon.

In 5-XI, there is what amounts to diffused colonic obstruction and stasis, since the whole colon is diminished in calibre to about the size of the upper small intestine. One large loop of the ileum seems to be dilated—it is 17 mm. deep and 13 mm. in diameter, and it fills the right iliac region.

In 4-XVII, in which no ascending colon has been developed, coils of small intestine to the right of the cecum are filled with dark green meconium.

ANATOMIC POINTS FAVORING MECHANICAL OBSTRUCTION AND STASIS. (Plates V, VI; Figs. 6, 7, 9; Table XI).

It seems to be of value to recapitulate here the principal points where anatomic tendency to mechanical obstruction and stasis has been demonstrated in this study.

There are 5 such points in all cases where one finds existing only the basic redundancy of the pelvic sigmoid colon and the subgastric transverse colon. These are in the neighborhood of

(1) The left psoas at the brim of the pelvis;
(2) The proximal (subgastric) side of the splenic flexure;
(3) The subantral or subpyloric area of the transverse colon;
(4) The proximal (ascending colon) side of the hepatic flexure;
(5) The cecum—the ultimate meeting place of backward pressure from the whole length of the distal intestine and of forward pressure from the whole length of the proximal intestine.

To these five points may be added one inconstant point which may be developed in any case, *i. e.*, the lumbo-sacral area of the sigmoid colon, most often to the right of the median line but occasionally to the left.

One other inconstant point may exist or may be developed in some cases (especially when the stomach is empty), *i. e.*, secondary subgastric angulation immediately to the right of the splenic flexure.

In more than the majority of cases (10 out of 14 at term, 8 out of 12 fetal cases) one finds from one to several added points where an anatomic basis exists for a tendency towards mechanical obstruction or stasis. These added points are at the points of fixation of the redundant loops of the portions of the colon other than the pelvic sigmoid colon and the subgastric transverse colon—these latter being noted above.

In the order of numerical occurrence these added points are

(1) Along the course of the subcystico-duodeno-pyloric transverse colon—anywhere from the gall bladder to the pyloric antrum (1 or more points in 13 out of 26 cases—7 out of 14 at term, 6 out of 12 fetal cases);
(2) Along the course of the descending colon (11 out of 26 cases—5 out of 14 at term, 6 out of 12 fetal cases);
(3) Along the course of the ascending colon—distal to the cecum and proximal to the hepatic flexure (9 out of 26 cases—7 out of 14 at term, 2 out of 12 fetal cases);
(4) At the subhepatic transverse colon—at the distal side of the hepatic flexure and the proximal side of the gall bladder (9 out of 26 cases—5 out of 14 at term, 4 out of 12 fetal cases).

Combinations of these added points are frequently found in the same patient. These combinations and their numerical occurrence are noted in detail under Individual Occurrence of Redundancy of the Colon.

It remains to call attention to the mechanical obstruction offered occasionally by secondary fixed loops[82] (Fig. 2, *b*) and by larger or smaller fixed ripples in the course of the colon.[83]

THE PRENATAL STOMACH.

SHAPE AND POSITION OF THE STOMACH. (Plates VII, VIII).

Summing up the opinions of anatomists, it may be said that there are three views as to the position of the stomach:—(a) the stomach is directed vertically from above downward and, according to some, also from behind forward; (b) the stomach is directed obliquely from above downward and from left to right and, according to some, also a little from behind forward; (c) the stomach is directed transversely from left to right.

In this study, upon lifting the left lobe of the liver and exposing the stomach, the body of this latter organ is found varying in position in all degrees from that described in the above group "a" through that described in group "b" (while that described in group "c" is readily developed experimentally from "b"), according to the amount of distension of the organ by gaseous, liquid or semi-liquid contents.

Also, observations and experiments made in this study show that in all cases, the varying degrees of change in position indicated in groups (a) (b) and (c) can be produced at will by inflating the organ with air or distending it with water.

And, further, that in all cases, by deflating or emptying such stomachs they return spontaneously to the form and position found in stomachs which had apparently never contained anything. This shape and position may therefore be called the resting or empty shape and position.

In 15 of the cases here studied (7 at term, 8 fetal cases), the stomach was found empty, the anterior and posterior walls being in apposition and the cavity obliterated. In 12 cases, (8 at term, 4 fetal cases), however, the stomach was more or less distended by gaseous or more or less liquid contents, the latter (and perhaps also the former), at least in some cases, perhaps introduced there during attempts at resuscitation. In 1 case, 0-XL, it contained a small amount of meconium.

THE RESTING OR EMPTY STOMACH. (Plate VII).

The empty (resting) stomach as here found lies high up in the left hypychondrium separated more or less from the vault of the diaphragm by the left lobe of the liver. Its direction approximates both the vertical and the horizontal, according as one has in mind the body or the antrum. Considering the viscus in its entirety as extending from the cardia to the pylorus and consisting of both body and antrum, one must say the resting or empty stomach is an organ which is bent upon itself at an angle which is usually less than a right angle but which may vary from an acute to a right angle, or, exceptionally, even more. This angle opens to the right and, usually, also upward; it also opens slightly forward.

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[82] Such as are found in the subgastric transverse colon in 9-XXV, 9-XXXVII, 7-XVIII; in the subcystico-duodeno-pyloric transverse colon in 9-XXV, 7-XVIII, 7-XLVII; in the descending colon in 9-XV; and in the ascending colon in 0-XL.

[83] Such as are found in the proximal subgastric transverse colon in 9-XLV; in the distal subgastric transverse colon in 9-XLVI, 8-XLI, 7-XLVII; in the subhepatic transverse colon in 9-XXXVII, 4-XVII; in the descending colon in 8-XLIV; and in the ascending colon in 9-XXXVII.

This duoform condition of the stomach is a permanent characteristic and the remembrance of it is of great practical importance, as further study will show.

The pylorus is usually found in the line of the cardia but on a plane slightly anterior to this latter. This causes a slight obliquity of the stomach, taken as a whole from the cardia to the pylorus—the obliquity being from above downward and from behind forward. This slight forward inclination is seen best defined along the lesser curvature but is most pronounced along the antrum as the pylorus is approached.

With the pylorus practically in the line of the cardia, and the body-antrum junction to the left of the cardia, there must be a deviation of the body of the stomach to the left if the antrum be of any length; and taking the point of departure from the cardia, one would express this deviation by saying the body is directed downward and to the left, and perhaps a little forward. But, although the empty stomach lies thus in continuity with the esophagus, the rounding up of the fundus suggests a new point of departure; so in proportion as the fundus is taken as a basis, one might consider the direction of the body as more vertical. But in most cases even taking the fundus as a point of departure, the direction of the body tends to be markedly downward and more or less to the left.

THE BODY OF THE EMPTY STOMACH: TWO VARIATIONS IN SHAPE—QUADRANGULAR; PYRIFORM. (Plate VII).

The body is an enlarged, flaccid, flattened sac, its two walls, anterior and posterior, being in apposition. The line of the lesser curvature along the body may be oblique (rarely more or less vertical) or more or less curved; in the latter case, the convexity is always directed to the left. In all cases, the line of the lesser curvature tends to be directed slightly forward as the antrum is approached.

A definite fundus is present in all the cases examined, regardless of the general shape, though it varies in the degree of its development. It lies close up under the left vault of the diaphragm, separated more or less from the latter by the left lobe of the liver.

Two variations are observed in the shape of the body of the stomach —(a) quadrangular (12 out of 14 cases at term, 10 out of 12 fetal cases), and (b) pyriform (2 out of 14 cases at term, 2 out of 12 fetal cases).

The quadrangular body is so-called because as it lies flattened it most resembles a quadrangle with rounded angles. It is longer than

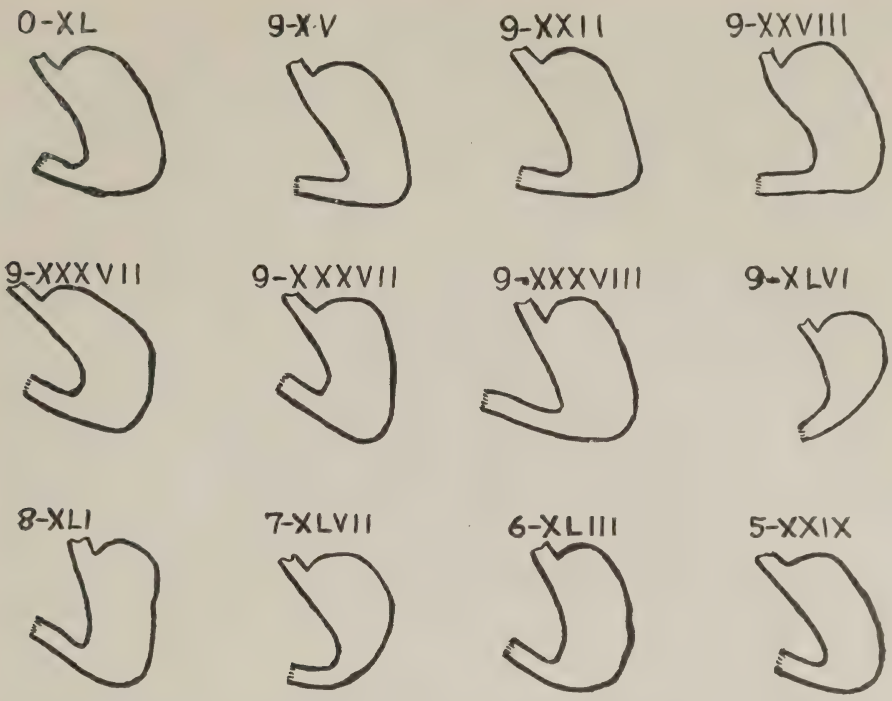

Plate VII—Diagrams of Stomachs as found Empty (0-XL appears empty but on section its walls were found separated but not apparently convex and it was found to contain meconium. 9-XXXVII, left, is empty as found; 9-XXXVII, right, is the empty shape and position to which the stomach returned spontaneously after deflation (from the distended shape and position in plate VIII).

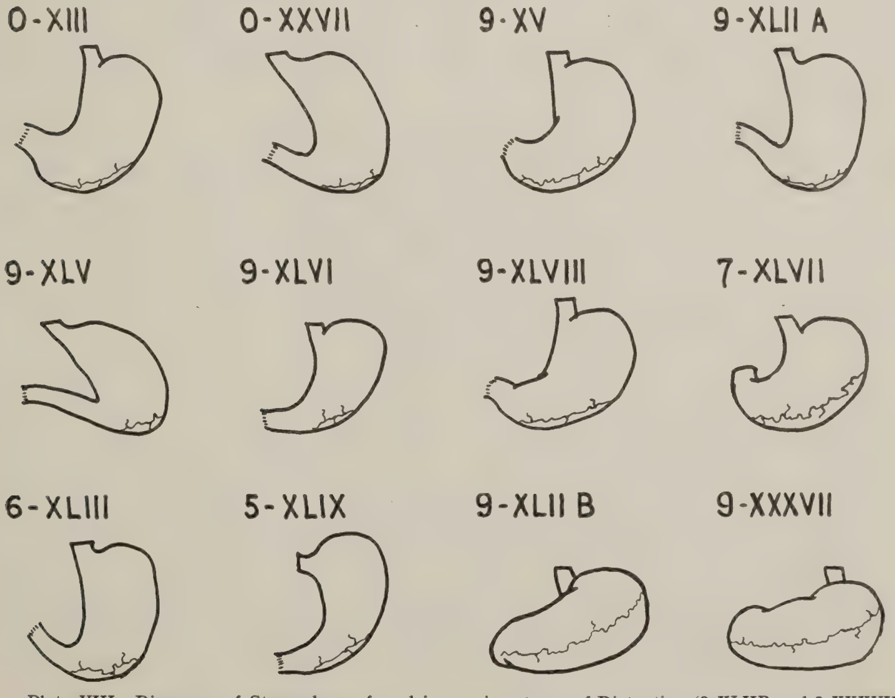

Plate VIII—Diagrams of Stomachs as found in varying stages of Distention (9-XLIIB and 9-XXXVII were distended experimentally). 0-XL in Plate VII illustrates the first stage of distension, *i. e.*, no change from the empty shape and position except separation of the walls by semi-solid contents (meconium).

wide and it has two walls, as above described, and four borders—superior, inferior, internal or right, and external or left; it has also four rounded angles—supero-internal, supero-external, infero-external and infero-internal. These terms describe themselves. The inferior border may be a slightly curved line or it may round down more or less in a manner similar to the rounding upward of the superior border. The breadth of the lower part of this body approximates the breadth of the upper part.[84]

The pyriform body differs from the quadrangular one in that the infero-external angle is missing, and the external and inferior borders merge insensibly. The external border passes more or less obliquely from the region of the supero-external angle, rounding downward and to the right, to become continuous with the lower border of the antrum, Thus, the pyriform stomach is relatively smaller than the quadrangular stomach. The rest of the body may retain the same general relations as described in the quadrangular body; or not only the infero-external angle may be missing but more or less of the infero-external part of the body. In 1 case the stomach is pyriform and appears rather under-developed, so that with a small fundus and the absence of the infero-external part of the body, the body as a whole resembles more a simple expansion upward of the antrum (9-XLVI).

THE ANTRUM OF THE EMPTY STOMACH.

The antrum is a quill-like tube, more or less cylindrical, feeling like rather firm fibrous tissue. It begins abruptly at its junction with soft, flaccid body of the stomach (body-antrum junction), and terminates abruptly at its junction with the soft, flaccid duodenum (duodeno-pyloric junction or pylorus).

The body-antrum junction is more or less to the left of the line of the cardia (in 9-XXXVIII, in which the antrum is unusually long, it is in the left parasternal line) and the body opens into the antrum from left to right, usually also from below upward (in 9-XLVI and 5-XLIX it opens rather from above downward), and perhaps a little from behind forward. The antrum opens into the duodenum from left to right and, usually, also a little from below upward.

THE DISTENDED STOMACH. (Plate VIII.).

The observations and experiments here made would indicate that the stomach is an organ which has physiologically a wide range of variation in form and relative position; these variations depending upon the amount of distension of its cavity, upon the density of its distending contents and upon various modifying factors entirely outside of the viscus itself.

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[84] Two variations of the quadrangular stomach are observed: in 1 case it resembles a half-moon; and in 1 case, it resembles a three-quarter moon (9-XXXVII).

The stomach is continuous, proximally, with the abdominal portion of the esophagus and, distally, with the 1st portion of the duodenum. Of these two extremities, the esophageal end seems to be the more fixed, and the duodenal end the more mobile. Between these two extremities, the region along the line of the lesser curvature seems to be the most stable.

All portions of the stomach are distensible and tend to merge themselves in each other, so that the tendency of the distended stomach is in the direction of a return towards its original tubular form but expanded towards its proximal end (fundus) and narrowing towards its distal end (pylorus). This tendency towards the tubular form is further modified by the predominant expansion of the body and by the tube being bent upon itself, the body-antrum angle remaining.

The lesser curvature appears less distensible than any other portion and tends less to become merged into the adjacent parts. Hence, it retains its identity perhaps more than any other portion; and the lesser curvature, with its attachments, seems to act with the diaphragmatic esophagus, the fixed fundus and the fixed part of the 1st portion of the duodenum in forming a relatively fixed region upon which the stomach as a whole swings—in its movements of distension (as contents are added to it) and of retraction (as it becomes emptied of its contents).

Furthermore, the lesser curvature appears to act toward preserving the original shape of the stomach, conserving more or less the rounded angle uniting the two main divisions, body and antrum; or, at most, converting it into a curve which looks in the same direction as would the rounded angle. Thus, even when the stomach is distended with gas or liquid, if both ends are tied, it retains its shape when removed from the body. The conservation of the original shape of the stomach depends also to some extent upon the greater curvature which, while to some extent distended, still also preserves its identity.

Thus, both the quadrangular and the pyriform empty stomachs tend to become really pear-shaped as they are distended but in the case of hyperdistension, the quadrangular body tends to give a more definite elongated-melon suggestion. (Plate VIII, 9-XXXVII).

Observations on stomachs found in various stages of distension, and experiments in distending the stomach to varying degrees, with air and water, may be summarized as in the following paragraphs. The conditions existing in the cases in which, on opening the abdomen, the stomachs were found more or less distended, could be duplicated at will by varying the amount of distension of the stomach and the density of the distending contents. In these cases, as well as in all the cases studied or experimented upon, evacuation of the contents of the stomach was always followed by retraction and a return of the organ to the resting or empty position.

PROGRESSIVE CHANGES IN THE SHAPE AND POSITION OF THE STOMACH AS IT IS DISTENDED. (Plate VIII).

Attempting to ascertain the full cycle of variations described by the stomach in passing from the condition of emptiness to a condition of full distension, progressive changes in the form and relative position were observed. These experiments were repeated many times, and in no case, so long as the viscus remained *in situ*, was the elasticity of the stomach exhausted by the experiments made. The limits of elasticity have, therefore, not been determined.

When the stomach is found partly distended, its contents are gravitated partly into the fundus, this being in the supine position the most dependent part of the viscus. On raising the subject, the contents gravitate towards the lower part of the body which then becomes the most dependent part, the fundus flattening and the anterior and posterior walls of the upper part of the body falling together proportionately to the degree of emptiness. (The changes occuring in the supine position are described here, as being basic; modifications resulting from changing the position of the trunk are detailed in Section III.)

CHANGES IN SHAPE.

When air or water is introduced into the stomach through the esophagus, the body and fundus appear to puff out, the lower part of the body most evidently. The anterior and posterior walls separate, change from flat to convex, and appear to increase in area; the borders round out and appear to increase in area, and they merge more or less into the walls, the internal (lesser curvature) remaining the most distinctly differentiated; the external (greater curvature) is marked by the attachment of the great omentum and the line of vessels of the greater curvature.

Continuing the distension, the antrum shares in the distension of the body and fundus, yielding more towards its junction with the body and gradually decreasing towards its junction with the duodenum. The angulation of the lesser curvature becomes more rounded, but the lesser curvature as a whole retains its concave formation.

CHANGES IN POSITION.

As soon as the stomach begins to dilate to any extent, it begins to move, appearing to rotate upon several axes. (The earliest stage of distension seen was in 0-XL. Here, the stomach was found quadrangular and flattened, and it appeared to be empty, but on section it was found to contain sufficient meconium to separate its walls but to produce none of the other phenomena of distension.)

CHANGES IN POSITION OF THE BODY.

The first movement is a slight forward and upward movement of the body, like a rotation on a transverse axis in the neighborhood of the cardia, movement being most marked at the lowest part of the body, and causing the vessels lying along the greater curvature to become visible anteriorly. These vessels are visible first along the lower border of the body, (Plate VIII).

Increasing the distension, this forward and upward movement is increased and to it is added a movement downward, forward and to the right, the fundus remaining domed up under the left lobe of the liver and the diaphragm.

As a result of these movements, the fundus and body now lie obliquely from above downward, from left to right and from behind forward; the anterior wall instead of looking forward looks more upward and forward, and the posterior wall instead of looking backward looks more downward and backward; while the greater curvature describes a course downward, forward and to the right, its line of vessels looking forward and upward and appearing progressively, first, along the lower border of the body, next, along the infero-external angle, and, next, along the outer border.

Still increasing the distension by increasing the amount of contents, the movement downward, forward and to the right is increased. At the same time a second upward and forward rotation appears.[85] As a result of these movements, while the fundus continues to remain domed up under the left lobe of the liver and the diaphragm, the stomach as a whole extends further to the right and tends towards a horizontal position, the line of vessels along the greater curvature looking almost directly forward.

Changes in Position and Direction of the Antrum.

As the body movement is sufficiently increased, it extends to the antrum. Thus, the initial upward and forward movement of the body extends to the antrum, but this stage of distension quickly leads to the added movement of the body downward, forward and to the right.

As the body moves downward, forward and to the right, the proximal end of the now dilated antrum moves in the same direction, and the antrum appears to rotate upon its distal extremity, the pyloric end. The body-antrum junction, from being to the left of the line of the cardia, is moved, as the distension increases, towards the median line or even to the right of the median line (as far as the right sternal line or even further).

And as the body-antrum junction is moved to the right, the direction of the antrum as a whole becomes more and more antero-posterior. Hence, instead of opening from left to right, and from below upward, and perhaps also a little from behind forward—when distended to any extent, the stomach as a whole is so rounded on itself at this point that the body may open into the antrum from before backward, and a little to the right, or perhaps to the left, and probably also a little upward, or perhaps a little downward—depending on the degree to which the body rotates downward, forward and to the right, as well as upward and forward. And this seems to depend primarily upon the amount of distension of the stomach, though it is influenced by other factors.

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[85] This second movement of upward and forward rotation tends to neutralize the increased movement downward, forward and to the right, so that only the increased movement to the right may be apparent. If the density of the distending contents is increased, the increase in the downward and forward movement is more apparent.

CHANGES IN POSITION OF THE PYLORUS, RELATED CHANGES IN POSITION OF THE FIRST PORTION OF THE DUODENUM.

The degree to which the direction of the antrum becomes antero-posterior depends also upon the position of the pyloric end. This pyloric end may remain in practically the same place as when the stomach was empty; or it may be moved to the right or upward, or downward and forward, or more or less in combinations of these directions. And wherever the pylorus moves, it carries with it, to a varying extent, the internal or movable part of the first portion of the duodenum. This movement of the pylorus seems to depend on the amount of distension and movement of the stomach but it must also be directly correlated with the extent of its attachments and with the length and mobility of the first portion of the duodenum.

The forward movement of the distended stomach tends to displace the antrum and pylorus also forward; this causes a forward displacement of the attached 1st portion of the duodenum. As a result of this, the part of the duodenum which is attached to the pylorus looks more or less directly forward, and causes a tendency to kinking (and sometimes torsion) at the point where this portion of the duodenum changes its direction, or where this portion of the duodenum becomes less mobile.

In the movements of the stomach above described, the esophageal end remains the more stable, the fundus continuing domed up under the left lobe of the liver and the left vault of the diaphragm.

FOUR STAGES OF THE DISTENDED STOMACH; CHARACTERISTIC SHAPE AND POSITION IN EACH STAGE. (Plate VIII).

Analysis of the foregoing changes shows that during the process of distension the stomach is continually modifying its shape and position. It is possible, however, to discern four stages in the distension of the stomach, each stage being characterized by definite modifications in the shape and position of the stomach. While these stages are not separated by rigid lines of demarcation, since each one tends to merge into the next, nevertheless, certain salient characteristics are more prominent in each.

The *first stage* of the distended stomach may be considered the one found in 0-XL, in which only a small amount of semisolid contents had been introduced.

In this stage, the stomach retains practically its empty shape and position, the only change being the separation of its walls but this may not be enough to make them appear convex nor to cause any apparent change of position of the stomach as a whole.

The *second stage* of the distended stomach may be considered the one found in 0-XXVII, 9-XLIIA, 9-XLV, 6-XLIII, 5-XLIX; and produced experimentally many times.

In this stage, the stomach retains more or less its original shape; the anterior and posterior walls are separated and have become convex; the borders and angles have become rounded; walls, borders and angles begin to become merged into each other; the proximal end of the antrum may or may not begin to be distended.

The stomach as a whole has begun to rotate upward and forward, this movement being most apparent at the lower border of the body, at which point the line of vessels along the greater curvature begins to be more or less visible anteriorly.

In addition, this forward and upward rotated stomach may or may not have begun to move downward, forward and to the right, the fundus remaining in place. But this downward, forward and to the right movement is very slight; its beginning is evident in an increased inclination to the right of the long axis of the body, by a movement of the body-antrum junction to the right or, perhaps, by a slight movement of the pylorus to the right.

The long axis of the body may be directed obliquely downward and forward or downward, forward and to the left, or perhaps a little downward, forward and to the right.

The body-antrum junction may be moved more or less to the right. (In none of the cases here noted did it reach the median line).

The pylorus may or may not be moved to the right. (In 3 of the cases here quoted, it is noted that the pylorus is moved to the right, passing just to the right of the median line).

The antrum is still directed to the right.

The relations of the body, antrum, pylorus and first portion of the duodenum are not markedly changed, and all these parts are visible as before.

The *third stage* of the distended stomach may be considered the one found in 0-XIII, 9-XV, 9-XLVI, 9-XLVIII and 7-XLVII; and produced experimentally in others.

In this stage, there is increased rounding of the walls, borders and angles and more or less distension of the antrum which at its proximal end becomes more or less merged into the body.

The upward and forward rotation of the stomach is increased, so that the anterior wall looks more upward as well as forward, and the line of vessels of the greater curvature is visible to a greater extent and looks more forward.

Perhaps the most evident change is an increased movement of the stomach downward, forward and to the right, the fundus remaining in place.

The long axis of the body is definitely directed obliquely downward, forward and to the right.

The body-antrum junction is moved to the right; in one case, as far as "just beyond the right sternal line."

The pylorus is usually moved to the right; in one case, as far as 15 mm. beyond the right sternal line.

The proximal end of the antrum has been displaced so that the antrum is directed backward and to the right; sometimes also upward, sometimes downward.

The relations of the body, antrum, pylorus and 1st portion of the duodenum are all visibly changed, and as this stage advances, the proximal end of the antrum becomes more and more anterior, and the region of the body-antrum junction may be moved so far to the right or so far upward as to hide the duodeno-pyloric region more or less from view.

The *fourth stage* of the distended stomach may be considered the one produced experimentally in 9-XXXVII and 9-XLIIB and many others.

In this stage, there is a still further increase in the rounding of walls, borders and angles, with increased distension of the antrum which from its proximal end becomes increasingly merged into the body.

A second upward and forward rotation appears to be now developed so that the stomach as a whole tends to become horizontal, and the line of vessels of the greater curvature looks more directly forward.

There is increased movement of the body to the right, the fundus still remaining in place.[85]

The long axis of the body tends increasingly to approach the horizontal.

The body-antrum junction is moved further to the right; sometimes also further forward and upward.

The pylorus may or may not be moved to the right; it may also be moved upward.

The relations of the body, antrum, pylorus and 1st portion of the duodenum are still more visibly changed. The antrum, pylorus and 1st portion of the duodenum tend to be hidden by the distended body. Kinking tends to occur on both the body and duodenal sides of the antrum, and varying degrees of obstruction of the stomach and perhaps also of the proximal part of the 1st portion of the duodenum tend to develop. These latter changes (as well as those relating to the attached colon and other factors) are demonstrated in detail in Section III.

THE PRENATAL KIDNEYS

LOCATION

In 15 out of 15 cases at term and in 5 out of 13 fetal cases, the lower poles of both kidneys are found lying at the crest of the ilium or above this point at distances varying up to 11 mm. (9-XLVIII) and 7 mm. (8-XLI) in the two groups, respectively.

In the remaining 8 (fetal) cases, the location varies downward to extension below the crest of the lower fourth or fifth of the kidney (4-XVII, 4-XXIII). In 5-XVI, the left has ascended above the crest, while the right is still just below this point.

RELATIVE HEIGHTS OF LOWER POLES OF RIGHT AND LEFT KIDNEYS.

In 10 out of 15 cases at term and in 4 out of 13 fetal cases, both lower poles are at the same level. In 5 at term and 7 fetal cases, the right lies a few mm. lower than the left. In 2 fetal cases, the right is distinctively higher than the left.

THE PRENATAL UTERUS

ANATOMIC VARIATIONS NOTED.

In 9-XLVIII, a double ureter is noted in the left kidney. In 9-XLII, the left kidney is larger than the right. In 4-XVII, the right kidney is broader and thicker than the left.

LOCATION: HEIGHT OF FUNDUS.

The uterus lies between the bladder and the sigmoid colon and rectum, the fundus being overlapped by the distended or redundant sigmoid colon which lies in the hypogastrium. At term, the fundus extends above the symphysis to distances varying up to 30 mm. (9-XLV).

MIGRATIONS AND DISPLACEMENTS.

The uterus lies in the median line, the fundus looking upward and forward, but it is often rotated around a vertical axis so as to lie more or less obliquely, the fundus in such cases looking not only forward but also a little to the right or to the left.

To these two positions is often added a slight rotation upon an antero-posterior axis, resulting in a lateral displacement of the fundus towards one or the other side of the pelvis, making one cornu (with the appendages) higher than the other.[86] In the oblique position this higher cornu is also the more anterior, the rotation being a little postero-lateral.

In 1 case (9-XLV), the lower part of the uterus occupies the middle of the sacral concavity, the sigmoid colon or rectum lying to its left.

These variations show that the uterus is a viscus which is quite movable laterally and forward, the latter sometimes to such an extent as to develop a sharp anteflexion (9-XXXVIII). It was never found in any direct backward position of either version or flexion, but the fundus was not infrequently directed slightly postero-laterally to one or the other side.

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[86] In 1 case (9-XXII) the lateral displacement of the fundus was so marked as to make the right cornu (the higher) lie 5 mm. to the left of the median line.

SUMMARY

The line of the final prenatal disposition of the colon around the periphery of the posterior abdominal wall is varied by a greater or less amount of basic redundancy, with loop formation, in the pelvic sigmoid colon and the subgastric transverse colon. In a certain proportion of individuals a variable amount of redundancy, with loop formation, occurs also in other portions of the colon. In the ascending colon this variable redundancy is related to the descent of the cecum, so that two types of undescended cecum are noted. No definite correlation is discerned between the variable individual redundancy of the proximal colon and the variable individual redundancy seen in the three types of sigmoid colon.

The redundant loops of the proximal colon are practically all fixed, yet within their limits of fixation, they undergo definite movements of migration and displacement. But they retain their individuality; hence, they may be sought in definite parts of the abdomen and their composition and relations identified.

Five anatomic points favoring the development of mechanical obstruction and stasis are found in all cases. These are in the neighborhood of the left psoas at the brim of the pelvis, the proximal (subgastric) side of the splenic flexure, the subantral or subpyloric area of the transverse colon, the proximal (ascending colon) side of the hepatic flexure, and the cecum. To these five points may be added one inconstant point which may be developed in any case, *i. e.*, the lumbo-sacral area of the sigmoid colon, the area of stasis being found most often to the right of the median line but occasionally to the left. One other inconstant point may exist or may be developed in some cases (especially when the stomach is empty), *i. e.*, secondary subgastric angulation immediately to the right of the splenic flexure. In more than the majority of cases one finds from one to several added points; in the order of numerical occurrence, these are somewhere along the course of the subcystico-duodeno-pyloric transverse colon, the descending colon, the ascending colon and the subhepatic transverse colon, respectively; combinations of these added points are frequently found in the same individual. Spontaneous compensation for mechanical obstruction and stasis occurs as the result of interchangeability in the form of gathering or fulling-up of loops.

Distension, moving towards or reaching the point of dilatation, is noted in the pelvic sigmoid colon, the descending colon and the subgastric, the subcystico-duodeno-pyloric and the subhepatic transverse colons (also in the terminal ileum, in the jejunum, and in the 1st and 2nd portions of the duodenum).

The body of the prenatal stomach which is found empty shows two variations in shape, *i. e.*, quadrangular and pyriform; its long axis is directed downward and to the left, though it may approach the vertical;

and it tends to unite at an acute angle with the antrum, which latter is usually directed upward and to the right.

In the stomach which is found distended, both body and antrum tend to change in shape and position—while the fundus remains domed up under the left lobe of the liver and the vault of the diaphragm, the stomach enlarges (balloons) in all directions and it tends at first to rotate upward and forward, and later also to swing downward, forward and to the right, the direction of the antrum tending towards becoming more and more antero-posterior. The pyloric end of the antrum may or may not move; when it does, it carries with it more or less of the movable 1st portion of the duodenum. Sometimes more or less obstruction of the stomach and kinking or torsion of the 1st portion of the duodenum develop. Four stages of distension of the stomach may be discerned. When the contents are evacuated, the stomach retracts and returns spontaneously to the shape and position of one which has never been distended.

The lower poles of the prenatal kidneys show a varying ascent from below the crest of the ilium, so that at term they are at or above the crest; they also show a more marked tendency to be at the same level at term than in the fetal group.

The uterus at term shows a varying ascent of the fundus above the symphysis; it shows lateral and forward rotations, the latter sometimes to such an extent as to develop a sharp anteflexion; it was never found in any direct backward position of either version or flexion.*

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*Abstract of the preceding chapter (pp. 139-207).

The fundamental cause of Splanchnoptosis is abdominal incompetence, which is a developmental factor. Failures in the normal development of abdominal competence and visceral retention are correlated with the development of certain departures from the normal body form—the most constant of these departures being the retracted lower thorax.

Variations in these developmental processes ("normal," or retarded, or uncompleted, or reversive) may be observed in continual operation in all human beings, and the pictorial and plastic history of the race shows them to have been occurring ever since such history began.

Seeking to average the many individual variations so as to find an anatomic mean which shall serve as a workable basis for the introduction and interpretation of experiments which demonstrate anatomically the above conclusions drawn from clinical observations, the writer in this instalment presents a study of certain details of the later prenatal evolution of the liver and the sigmoid colon, with special reference to the status at term.

Individual variations in the location of the lower borders of the liver are found at all ages from at least the fourth month onward. The locations found predominating at term are also found in early fetal ages, and locations found predominating in early fetal ages are also found persisting at term.

The sigmoid colon is not the anarchic member of the body which it has been considered. It develops in three definite types according as its length permits the formation of 1, 2 or 3 inverted-U loops; its varied locations may be classified along four definite lines, and they are the result of migrations and displacements of these loops along well-marked paths; by the study of the laws shown at work all individual displacements of these loops may be retraced, the original type disclosed and the case so classified; the loops have no secondary fixed bases; as a result of this latter condition and of its constant parietal attachment in the left pelvic or suprapelvic abdomen, the sigmoid colon can always be reached surgically in the left lower quadrant, no matter what its location or type; distention of the sigmoid colon seems to be a normal phenomenon at term, it may lead to dilation, or it may lead to damming back of its contents into other portions of the intestine with distention or dilatations of these latter portions. Anatomic bases for the development of mechanical obstruction and stasis, as well as methods of spontaneous compensation for these processes, are demonstrated; also initial anatomic paths leading toward the development of torsion of loops. An experimental explanation of the possible formation of colon sacculations is also demonstrated.

(To be Continued)

EXTRAPERITONEAL CESAREAN SECTION (GASTROELYTROTOMY) IN PRESUMABLY INFECTED AND MISMANAGED CASES OF PROLONGED LABOR*

BY

By Asa B. Davis, M.D., F.A.C.S., New York, N. Y.

The methods by which a child can be delivered through the abdominal wall are still passing through a period of evolution and development. Many ingenious and different plans have been and still are being attempted. Some are found to be so lacking in merit that they soon, very properly, pass on into the discard. Some show many desirable advantages and yet are attended with serious disadvantages. It is altogether probable that the best method of performing cesarean delivery has not, as yet, been attained. We hear much about the abuse of cesarean section to the exclusion of the other well-known methods of delivery. This criticism, certainly, does not apply justly to large well-conducted maternities. An abuse which we undoubtedly do witness, both in maternity hospital services and in cases under the care of private practitioners, is the failure to recognize early in given cases that delivery through the pelvis will be fraught with great danger to mother and child or else is impossible of accomplishment. If this were not true it would not have been possible for the writer to have seen, during the past March and April, within five weeks, eight cases in which craniotomy was the only thing left to be done. These eight well-developed, full-term fetuses were either already dead or so near death that it would not have been possible to prepare an operating room quickly enough to give any promise of saving these children. The result was that eight, otherwise healthy, young women, except for the disproportion between pelvis and fetus, had passed through the risks and

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burdens of pregnancy, had been subjected to hours upon hours of ineffective labor and delivery by craniotomy. One mother lost her life; seven others, if so many survived, were childless. In seven of these cases the dystocia was due to either a well-marked funnel or male type pelvis. The eighth had a neoplasm, so situated that it made pelvic delivery impossible. These conditions should have been recognized during pregnancy, or at the latest early in the first stage of labor. Timely cesarean section was clearly indicated and would have saved these eight children and the mother who was lost. This is not a cry along a new trail. To go back not more than some seventy odd years, Cazeau, with rare comprehensive insight, pointed out the danger and objections to prolonged ineffective labor, especially with membranes ruptured. Nearly every textbook on obstetrics since his time reiterates the same thing, until we might properly write into obstetric history: "As it was in the beginning is now"—Are we to continue so that the remainder of the quotation, "and ever shall be, world without end," is to be applicable?

Autopsies at the Lying-in Hospital upon stillborn infants and upon those who die soon after birth are revealing some instructive, if unpleasant, facts. It is found that the number of these children who die from cerebral hemorrhage, after unduly long labors which are eventually either terminated spontaneously or by forceps or version, is unwarrantably large. Similar cases, which have been under the care of private physicians have been admitted to the hospital after long labors, unknown attempts at operative delivery and examinations, but with a living child in fair to good condition. It is this type of case which gives the high maternal and fetal mortality following cesarean section. It is this type of case, with disproportion between fetus and pelvis, long labor, with ruptured membranes, unclean examination, unsuccessful attempts at operative delivery, which has made it impossible for me, in an experience of more than twenty-three years and somewhat over five hundred and eighty cesarean deliveries, to reduce my maternal mortality much below eight per cent, although at one time I could show nearly one hundred consecutive cesarean sections without a maternal death. The different members of the attending staff at the Lying-in Hospital, as seems best to each one, are attempting to cope with the presumably infected case, by a technic other than the classical cesarean section, which gives a very high mortality. Some favor the transperitoneal method, some the so-called double flap method; some a technic which is near or quite extraperitoneal.

I have employed the double flap technic in three cases and have lost one mother and her child. This mother gave one of the most horrible exhibitions of septic infection which has ever come under our observation.

In 1918 I began to employ, for these presumably septic, unfavorable cases, practically the technic of Thomas, which the latter called "gastroelytrotomy." I have used it in twenty-eight cases and have lost two mothers and seven children, three of which were stillborn and four died after delivery,—a maternal mortality of 7.2 per cent, fetal mortality, 25 per cent.

Without any attempt at a review of the literature upon this subject, it may not be amiss to quote rather freely from what is found in the Fourth American Edition of Playfair's System of Midwifery, published in 1885, under the title, laparoelytrotomy. We learn that in 1820 Ritgen proposed laparoelytrotomy, leaving the peritoneum intact. He attempted such an operation unsuccessfully and was obliged to deliver his patient by cesarean section. In 1823 Beaudelocque the younger independently conceived and performed the same operation without success. In 1837 Sir Charles Bell conceived a similar operation, but there is no mention of his ever having performed it.

In 1870, Dr. T. Gaillard Thomas of New York read a paper before the Medical Association of the town of Yonkers, New York, entitled "Gastroelytrotomy, A Substitute For Cesarean Section," in which he described the operation which he had performed three times on dead subjects and once on a married woman with a successful issue as regards the child. It is further stated: "The object of the operation is to reach the cervix by incision through the lower part of the abdominal wall and upper part of the vagina, and through it extract the fetus as may most easily be done."

In a footnote we read as follows: "New York Medical Journal, Nov., 1878, Thomas operated twice, Skene four times, Charles Jewett of Brooklyn twice; Hime, Edis, Dandridge and Taylor of Cincinnati, and Walter R. Gillet of New York each once, in all 12; women saved, 6; children living but not moribund, 7; bladder lacerated in 6 cases. In properly calculating the risk of the operation it is fair to exclude the moribund case of Thomas, the intemperate and bedridden case of Hime and the diseases subject of Edis who survived, respectively, one hour, two hours and forty hours. The balance, nine cases, were favorable in four instances and unfavorable in five; six of the nine women recovered and five children were saved."

We may note in passing that while this operation is a much more difficult one to perform, the above results were far better than those obtained at that time by abdominal cesarean section.

The Thomas Technic

"The abdominal incision extends from a point an inch above the anterior superior iliac spine, and is carried, with a slight downward curve, parallel to Poupart's ligament until it reaches a point one inch and three quarters above, and to the outside of, the spine of the pubes. Beyond this point it must not extend, in order to avoid wounding the round ligament and the epigastric artery. In this incision the skin, the aponeurosis of the external oblique, and the fibers of the internal oblique and the transversalis muscle are divided. The rectus is not implicated. After the transversalis fascia is divided the peritoneum is reached and readily lifted up intact, so as to expose the upper part of the vagina, through which the fetus is extracted." This report continues at considerable length in its description of the anatomic relations and development of the upper part of the vagina during late pregnancy and the difficulties and dangers attendant upon opening it—stating that in Beaudelocque's case, because he incises instead of tearing the vagina he was obliged to discontinue the operation on account of the loss of blood.

While the technic employed in operating upon the cases which I report is in principle, based on the foregoing as described by Dr. Thomas, it differs from it, I believe, in some essential particulars and results.

PRESENT TECHNIC

Starting at a point on a level with, and about 2 cm. to the left of, the right superior iliac spine an incision down to the aponeurosis of the external oblique muscle is extended obliquely downward and inward to the middle line parallel to, and slightly above, Poupart's ligament, the inner end being slightly above the spine of the pubes. As the superficial epigastric artery and other vessels come into view they are double clamped, divided and ligated. It has been found that this is a time saving precaution, in that it keeps the field of operation clear. The edges of the wound are retracted and in succession the remaining layers of the abdominal wall are divided, where possible separating the fibers. The transversalis fascia is opened the whole length of the wound. Passing the hand close to the posterior surface of the front wall of the bony pelvis the bulging peritoneum can be readily lifted, and, covered with a pad moistened in warm salt solution, is held out of the way in the upper and outer part of the wound by a retractor. No attempt is made to expose or open the vagina, although it is sometimes opened for a short distance in cases where more room is needed. The bladder is more readily manipulated if it contains just enough fluid to give it outline. With a boring movement of the fingers at the upper and right margin of the exposed portion of the bladder, its posterior wall is readily reached and an easy line of cleavage is found. Passing the fingers up to the uterovesical fold the bladder can readily be freed from above downward and to the left. This exposes the anterior portion of the lower uterine segment, a large area in a pregnant uterus developed to full term. While a wound of the size and location as described is necessary, it is well, in so far as possible, to keep manipulations away from the outer end of the opening. In my hands, failure to do this has several times resulted in such complications as making a small opening through the peritoneum, tearing across the circumflex iliac artery, resulting in annoying delay from a wound quickly filled with blood, and the necessity to find and ligate the bleeding point, and the undue exposure to injury of the external iliac artery.

Considerably more room can be gained by partially dividing the tendon of the right rectus and the pyramidalis muscles rather close to the right pubic spine. The bladder is covered with a moist pad and retracted downward and to the left. The exposed portion of the uterus is thinned and bulged forward by the presenting part of the fetus. Retracting the wound as far as possible to the left a vertical incision is made close to the left side of the abdominal opening and from below the uterovesical fold downward far enough to furnish an opening sufficiently large to allow the delivery of the fetus. Sometimes, but not in all cases, this opening extends into the upper part of the vagina. At this time it is well to take a culture from besides the presenting part of the child. By this location of the uterine opening as described, and by the usual dextrotorsion of the uterus, should this opening be extended by laceration during the delivery of the fetus, there is less likelihood that the uterine artery will be reached and torn across. In my earlier operations this accident happened in several cases. Proceeding now with the delivery;—forceps were usually applied, but except in two or three instances delivery has proved unsuccessful by this means. Nearly all of the children have been delivered by internal podalic version and breech extraction, followed immediately by manual extraction of the placenta and membranes. Unless more than usual precautions are observed, the overstrained but now relaxed uterus is more than likely to give an exhibition of several quick profuse hemorrhages in which the total loss of blood is considerable. The fundus should be promptly held and 1 c. c. of pituitary extract should be injected deep into the muscles of the thigh. From observation and experience I have reached the confirmed belief that pituitary extract should have no place in obstetric practise until the uterus is empty. In case a portion of the vagina is opened and annoying bleeding results from the cut edges, this can be overcome by digital compression or by several deep temporary sutures passed parallel to, but well back from, the edges of the wound, to be removed after permanent closure.

The opening in the uterus is closed by two or three layers of sutures with a continuous suture close to the deep edges of the uterine wall. Several interrupted sutures and a continuous Lembert suture complete this part of the operation. Sometimes the uterus has so thinned that it is difficult to find room for three layers. The bladder and peritoneum are allowed to resume their normal location.

The divided portion of the tendon of the right rectus and the pyramidalis muscle are carefully approximated and secured by several interrupted chromic sutures. A continuous suture closes the transversalis fascia; another layer of interrupted sutures secures the muscle fibers. The edges of the aponeurosis of the external oblique muscle are overlapped by the use of the mattress sutures and the free edge secured by a continuous suture. The remainder of the wound is closed with silkworm gut sutures. In earlier cases I employed strands of chromic gut or rubber tissue carried down to the fascia. Soon I abandoned the use of any drains. No better results were obtained with than without drainage.

It should be borne in mind that all of the cases herewith reported were septic to a greater or less degree. All of these cases had high temperatures after operation. In no case was it possible to secure primary union of the abdominal wound. Two showed only an oily discharge for a day or two from two or three stitch holes. In twenty-one cases, part, or the whole length of the wound separated down to the aponeurosis. In four cases the whole depth of the wound broke down with considerable sloughing. Two patients died early before the repair process had time to exhibit what would have happened. The wounds healed readily, and in all cases the infection remained local, with the exception of two or three cases in which there was mild tenderness down the inner part of the right thigh, as of a very slight phlebitis. I have had no evidence that the uterus was infected, or that its wound failed to unite by primary union. In a few of the cases there must have been a very localized peritonitis. With the exception of one case, either by symptoms or leakage, there has never been any suggestion that the bladder had been injured or later become infected. One case which sloughed badly had a vesical fistula for a short time, which soon closed spontaneously.

It is not surprising that considerable fat necrosis occurred in many of the cases from traumatism due to retraction. Because of open wounds the stay in the hospital was usually quite prolonged. In four cases we freshened the granulating surfaces and the skin edges, and resutured the wound after sloughing had ceased. Healing was almost perfect in every case and the necessary stay in the hospital was considerably shortened. All of these patients were tired out and exhausted.

The operation is physically and technically a very difficult one to perform. In early cases, I spent something over two hours, later being able to perform this operation in about fifty-five minutes. Much time was lost because of the failure to secure bleeding points before or at once after vessels were cut. Very much more time was lost before I learned how to detach the peritoneum and also in the attempt to detach and separate the bladder along its right side, where the line of cleavage is not distinct. Notwithstanding the previous condition of these patients, and the fact that they were subjected to a long difficult operation, their early postoperative condition was remarkably good. Vomiting was never a distressing symptom, and abdominal distension was almost entirely absent.

In Dr. Thomas' report, considerable stress is laid upon the danger of injuring the deep epigastric artery. From early reports, opening into the bladder was rather a common accident. I cannot recall that the deep epigastric artery ever came into view or was injured in any of the cases. In one case only there appeared a urinary fistula. This became evident after the tenth day postoperative, and was believed to have been due to the neighboring sloughing. In two cases the right round ligament, and in one, the right ureter, were innocently in evidence. They caused no inconvenience, and so far as I was able to determine they suffered no injury. Usually the widely expanded pregnant uterus tends to carry these structures far out to the sides and out of the way.

Some of the more salient points of interest in connection with these cases are that there were sixteen primiparae, one para ii, five para iii, one para iv, one para v, one para vi, two para vii, and one para viii. The ages ranged from seventeen to forty-one. Twelve of these cases were wholly under the care of the Lying-in Hospital. The remaining sixteen had been under the care of other physicians and midwives for an unknown number of hours. Of the two mothers who died, one was forty-one years of age, and a para viii. She had been under the care of an outside physician, and a midwife. She gave a history of having had three living children. The first was stillborn; an instrumental delivery. The others were difficult deliveries. The second was a small sized child, the third was a large child, the fourth of medium size and difficult delivery. She had also had three abortions in the third month of pregnancy. In the labor under consideration the child weighed 4,160 grams and lived. The mother died on the second day, of general peritonitis. There was serosanguineous fluid in the peritoneal cavity and cultures showed hemolytic streptococci. This woman had a contracted pelvis, and reported that all of the living children had been injured by the stretching of the brachial plexus.

The other patient who died was twenty-seven years old, a para i, who had had outside medical attendance for an unknown number of hours before admission. A forceps delivery had been attempted. The patient gave a history of having had pneumonia three weeks before labor. Her child weighed 2,020 grams and lived. She was in poor condition on admission, and it was my impression that the cause of her death was pneumonia plus labor, rather than the reverse. No culture was taken in this case.

In all of the twenty-eight cases reported the fetal heart was heard just before operation was begun. Three babies were stillborn. In these cases there were marked tonic contraction of the uterus, and evidence of fetal distress as indicated by the escape of meconium and a varying fetal heart. In one of these stillbirths, the mother was a girl of seventeen years, who had been under the care of an outside physician, and a midwife. Hydrocephalus and spinabifida were found in the child. It was a face presentation.

Four babies died. One child died after four and a half days; another on the nineteenth day from a very extensive pemphigus. The mother in this case showed a four plus Wassermann reaction. The third child weighed 4,870 grams and died on the labor day; the autopsy showed atelectasis and asphyxia. The patient had been in labor for a long while prior to admission to hospital. The fetal heart was from 140 to 180 prior to operation. In the case of the fourth child, labor was said to have been in progress for three and a half days under outside care. The child weighed 3,400 grams, and died six hours after delivery.

All of the cases wholly under the care of the Lying-in Hospital, with trial labor going on for so long a time, and in some instances attempted forceps delivery, had been for this reason rendered unsuitable cases for classical cesarean section. All of these mothers survived. A stillbirth occurred in one case after sixteen hours' labor. One child died on the nineteenth day from pemphigus; the mother was syphilitic.

Six of these patients in a subsequent pregnancy have come under my care. One in the third month, when assured that she was pregnant, declared that her husband demanded that she should have abortion induced. Nothing further has been learned about her. The other five continued to the full term of pregnancy. One had an almost precipitate spontaneous delivery of a very small child. Four others were delivered by me, by classical cesarean section. Bimanually, with one hand through the cesarean opening in the uterus, the site of the former extraperitoneal operation was carefully examined in each case. It was rather surprising to find how well the uterine wall had closed and how little in evidence were adhesions in the neighborhood. In no instance was there found any weakening or hernia at the site of the former opening in the abdominal wall.

I am more and more impressed with the importance of securing the essential points in the history of every pregnant woman. The primiparous patient is an unknown quantity, obstetrically speaking, but in her case it is important to learn whether she has any history of disease, previous illness, or operations, which may have some bearing upon the course of her pregnancy and approaching confinement. This also holds true of the multiparous woman, but also a searching inquiry should be made into her previous obstetric history. In women who are able to develop a fetus through pregnancy and into labor, with our present knowledge and equipment, it should be impossible to obtain histories of two, three, four, and in one of our cases, of five consecutive stillbirths or the delivery of injured children who soon die, and certain others who are not so fortunate as to die, but are elected, because of birth injuries, to materially swell the ranks of the incompetent and overcrowded institutions for the crippled and feeble minded. Patients giving histories of difficult or operative deliveries with bad results should be examined as to the cause of this. They should be watched with unusual care in each individual case. Some means should be found by which the previous course should not be repeated, even delivery by cesarean section if that is the best procedure in a given case. But the condition should be foreseen and provided for.

After the patient's history has been taken there should be a general examination sufficiently thorough to indicate whether she is suffering from pulmonary or cardiac disease. Then should follow the routine obstetric examinations, which should include height, weight, breasts and nipples, abdominal measurements, palpation, and auscultation for the fetal heart, external and internal pelvimetry, blood pressure, urinalysis and the Wassermann test. I find that about 2 per cent of all applicants at the Lying-In Hospital, show a positive Wassermann reaction.

Pelvimetry is important and should in no sense be neglected. Patients having contracted pelves, should be under careful observation. If they are given the opportunity and the observation be close enough, we shall see that a large proportion of such cases will deliver themselves without assistance, or at most, by the aid of easy forceps. The remainder of such cases have either declared themselves by their former history, or they soon make it evident that they require some form of operative assistance—forceps, version or cesarean section. Many of the patients with distorted and contracted pelves habitually give birth to small children; often the skull bones are thin and capable of being dented like a sheet of celluloid; they have wide suture spaces; the fontanelles are large. Such heads will mold and pass through surprisingly contracted pelves. In former times we were instructed: Given such and such pelvic measurements, such and such management of a case should be carried out.

We still see, from time to time, publications giving this same sort of advice. The wise obstetrician will do nothing of the sort. He will take pelvic measurements as he would a laboratory report as a part of the data in the individual case under observation at the time, and from the previous history, from the measurements, from the contour, muscular make-up of the uterus and abdomen and their driving force, and above all from the size, shape and moldability of the fetal head, he will decide whether that particular head will pass through that particular pelvis. If his stock of wisdom still holds out and he considers the interest of mother and child and his own peace of mind, he will determine this fairly early, before the patient is exhausted and the fetus shows signs of distress, and the liability to infection has been increased by ruptured membranes and manipulations. It is becoming fairly easy to detect these cases with contracted pelves, or disproportion between pelvis and vertex, which will require some form of operative assistance in delivery. It has seemed to me that this type of case is rather decreasing in numbers.

There is another distinct type, seen much more frequently than formerly, and far too little called to notice by teachers and writers. I refer to the woman having the male type or funnel pelvis, nominate them as we will. They are difficult to detect and they require the keenest kind of obstetric judgment and skill to carry a given case of this kind through labor with safety and success for mother and child. Here pelvimetry gives no assistance whatever. These patients are usually of medium height, stocky build, with apparently broad hips. They have the appearance of robust health and vigor. They are well nourished, buttocks and hips especially are made up chiefly of large cushions of fat. Their external pelvic measurements are up to or above normal. The lumbosacral angle is accentuated. A horizontal plane passing through the promontory and another through the symphysis pubes are far apart. The pelvic bones are thick and strong. The pubic arch may or may not be narrowed. The internal, diagonal conjugate, if the promontory can be reached, not infrequently measures twelve or more centimeters. Sometimes the contour of the pelvis below the inlet is well formed and of ample capacity. In other cases one or both of the side walls of the true pelvis are flat and tend to converge. The pelvic inlet would be ample for an ordinary moldable vertex, and in many of the cases, if a large part of the vertex would pass through the inlet with a fully dilated cervix, there would be comparatively little difficulty in completing pelvic delivery. But the pelvic make-up and capacity is but one side of the equation. Such patients habitually give birth to large children with hard, square block-like heads, with thick dense cranial bones and suture lines and fontanelles which are hardly discernable. Membranes are apt to rupture before or soon after the onset of labor. Posterior positions are rather frequent. Such cases are deceptive because a considerable segment of the vertex sets into the inlet like a ball valve; it does not advance. Such dilatation and thinning of the cervix as takes place is slow. In many cases labor is neither continuous nor vigorous. One is apt to be misled by the hope that active progressive labor will soon begin resulting in dilatation of the cervix and advance on the head. Such cases are apt to develop tonic contraction of the uterus and thin out the lower uterine segment, risking rupture of the uterus, compressing the vertex down against the inlet and the placenta against the child. As if this were not danger enough, far too many of these cases are given pituitrin at this stage. It would be bad practice to give ergot under such conditions, but pituitrin, which acts with great suddenness and force within four minutes after its injection, as I have repeatedly witnessed in cesarean operations, after the uterus was empty, by some strange reasoning, in the minds of not a few, appears to be good treatment. These cases are difficult and dangerous for mother and child; they belong in a hospital. They certainly should not be attempted single-handed and alone in the patient's home. In many of them if pelvic delivery, dilatation and incisions of cervix and forceps are persisted in, the operator does not usually look upon his completed work with pride. If version is attempted, too often the results are not good. Many of them become unsafe, because of the risk of sepsis, for classical cesarean section, unless this is done early. This type of case gives the high percentage of stillbirths, cerebral hemorrhage, broken necks, children in whom the heart continues to beat for an hour more or less, and yet it is impossible to start respiration, or those who die soon after birth. Would it not be better to foresee some of this early and "abuse" cesarean section in more of these cases and do it early when it is comparatively safe for mother and child? If the mothers are made to understand, there is no doubt regarding the answer which they will give.

Resume and Conclusions

1. The sooner the general public, both lay and medical, come to the realization that reproduction is potentially, and in ten per cent of the cases, actually a pathologic process, and act accordingly, the sooner childbed will be removed from the position which it now holds in this country as, next to tuberculosis, the cause of the greatest number of deaths.
2. Every pregnant woman should be under competent obstetric care

and instruction soon after conception, through gestation, labor and the puerperium, which should continue until everything possible has been done to restore her to her normal activities of life in good condition. Ninety per cent of pregnant women should be under careful observation, but aside from a few simple precautions and instructions, as long as they are progressing favorably, should be treated to a very generous share of masterful letting alone. It should always be kept in mind that some from this larger class have a way of moving, gradually or abruptly over into the abnormal class.

3. The emergency obstetric case should disappear. It is this type of case which magnifies the morbidity and mortality of obstetric records. So long as such cases do occur, the well equipped maternity hospital should receive them, even though they are apparently about to die. With such aid, some of the seemingly hopeless cases will recover. There should be some way of checking up the activities of the doctor who is repeatedly showing bad results. Such an one should be rather actively encouraged to direct his energies along less dangerous lines.

4. We can often see more by looking backward. We would accomplish more, with better results, by looking ahead. Preventive obstetrics should be a widely broadcasted slogan. The public should be taught to be more critical of obstetric result, and not to so complacently accept dreadful injuries to mother and child, or death of one or both, as the Will of an overworked Providence. Extraperitoneal cesarean section will save some lives that would otherwise be lost. Classical cesarean would have saved but few of the cases reported.

Case Reports

Case 1.—C. N. 41815, aged twenty-six, a para i. Operation October 25, 1918. She had been under the care of an outside physician. In labor three days, membrane ruptured, pituitrin soon after labor began. Attempts at delivery, number of vaginal examinations unknown. Condition on admission: Temp. 101° F., tonic uterine contractions, fetal heart 156, poor quality, vertex R. O. P. Weight at delivery 3,300 grams. Stillbirth. Culture beside vertex before delivery from uterus showed staphylococcus aureus. Vertex not engaged. Pelvic bones thick. Internal diagonal conjugate 9.5 cm. Postoperative condition of mother good. Discharged twentieth day. Wound healed except 1 cm. superficial granulation at external end.

Case 2.—C. N. 42055, aged twenty-one, para i. Operation November 20, 1918. In labor 36 hours, membranes ruptured shortly before onset of labor. Repeated vaginal examinations, attempted forceps, whisky, coffee, morphine and pituitrin. General condition good, tonic uterine contractions. Internal diagonal conjugate 10 cm. Breech would not engage, no evidence of fetal distress. Cervix fully dilated. Extraperitoneal section,—living child weighed 3,750 grams. Slight temporary injury left sternoclavicular articulation during delivery. Culture from uterus before delivery showed staphylococcus albus, from abdominal wall later, staphylococcus aureus. Postoperative condition good. Discharged thirteenth day, wound healed, living child. Has since been delivered by me by classical cesarean; uneventful for both mother and child.

Case 3.—C. N. 42138, aged twenty-three, para i. Extraperitoneal delivery December 4, 1918. In labor five days, 10 or more vaginal examinations. Given "black pills" and chloroform. Forceps delivery attempted. Examination: small slight woman, poorly nourished, general condition only fair. Tonic contraction of uterus about fetus. Vertex overriding pelvic brim; fetal heart only fair quality, 160 to 165. Membranes ruptured. Left side of cervix showed recent laceration and portion of left vault of vagina torn away. Child delivered alive, weight 3,140 grams. Had right sided facial paralysis from outside attempts at forceps. Died fourth day, edema of lungs. Mother recovered. Discharged twenty-fifth day. Wound healed except two small sinuses,—discharging small quantities of serum. Cultures from uterus before delivery, staphylococcus aureus; from abdominal wall later staphylococcus albus.

Case 4.—C. N. 42173, aged twenty-eight, para i. Extraperitoneal delivery December 8, 1918. In labor 60 hours, membranes ruptured 25 hours. Private physician made five vaginal examinations. Had been given pituitrin 13 hours prior to admission, no attempts at delivery. On admission general condition only fair. Rough breathing lower left base. Tonic uterine contraction, well marked ring of Bandel, cervix fully dilated. Internal diagonal conjugate 10.5 cm. Fetus, breech L. S. A., partly engaged, tightly compressed by uterus. Weighed 4,000 grams, white and limp when delivered; respiration established with difficulty. Cultures not taken from uterus before delivery,—from partially broken down abdominal wound later, showed staphylococcus aureus. Recovery slow, discharged forty-fifth day. Wound open two inches,—one-fourth inch deep, clean, granulating. Child living.

Case 5.—C. N. 42754, aged twenty-nine, para i. Operation February 17, 1919. Sent from a hospital thirty miles outside of New York. In active labor for many hours before admission; floating head, funnel pelvis, membranes intact until ruptured by me twelve minutes before operation. History of repeated examinations by three physicians, no attempt at delivery, morphine had been given. Condition of mother and fetus fair. Living child weighing 3,650 grams. No culture taken. Puerperium uneventful. Mother and living child discharged seventeenth day.

Case 6.—C. N. 42838, aged thirty-eight, para vii. Operation February 26, 1919. Two stillbirths, a third died when two weeks old, one abortion at three and a half months, has two living children, three had been forceps deliveries, second and third children delivered spontaneously. Sent from outdoor service. Membranes ruptured spontaneously two days prior to delivery. Ten vaginal examinations, no attempt at operative delivery, morphine had been given. Systolic murmur without symptoms. Tonic condition well marked. Pelvis rachitic, contracted; Internal diagonal conjugate 8.5 cm. Vertex, R. O. A. overriding brim. Weight of child 3,625 grams, living. Profuse bleeding during and after operation, pulse rapid and irregular. Pituitrin given during operation. Left side of vagina torn from uterus, peritoneum opened, intestines exposed rent repaired. Cultures developed staphylococcus albus. Discharged with living child twenty-first day;—shallow granulating wound 3 to 4 cm. at outer end of abdominal wound.

Case 7.—C. N. 42859, aged thirty-five, para vi. Operation February 26, 1919. First child, attempted forceps, craniotomy. One abortion in fourth month. Three living children, all small, spontaneous deliveries. This labor wholly under care of hospital, in progress two days—membranes ruptured early, vaginal examinations three by staff, one by attending. Vertex L. O. A., impacted, contracted pelvis. True conjugate, 8 cm. Tonic contraction. Cervix edematous with old deep laceration. Condition of mother and fetus good. Ergotole given, delivery by version. During delivery opening four inches long torn into peritoneum, exposing intestines. Living child 3,675 grams. No cultures taken. Discharged with living child fortieth day,—wound almost healed.

Case 8.—C. N. 42948, aged forty-one, para viii. Operation March 11, 1919. One stillbirth, 3 abortions third month, 2 living children, first instrumental, difficult labor 36 hours, stillbirth. Second, small child, 10 hours labor, living. Third labor, 6 hours, large child, midwife and doctor, stillbirth. Fourth, medium sized child, difficult labor, 8 hours, living child. All living children said to have had brachial palsy. Present labor had been under care two private physicians, duration, examinations and attempts at delivery unknown. Condition of mother and fetus on admission not noted. Shoulder L. S. A., contracted pelvis, internal conjugate 9.5 cm., two examinations after admission. Operation uneventful, child weighed 4,160 grams, lived. Mother died second day. General peritonitis; bacteremia.

Case 9.—C. N. 45018, aged seventeen, para i. Operation December 25, 1919. Under care of midwife and private physician prior to admission, said to have been in labor 16 hours, membranes ruptured. Contracted pelvis. Impacted face, R. M. A. Ergotole given. Uneventful operation, child weighed 3,630 grams, still birth. Hydrocephalus and spina bifida. Mother weak, condition poor, wound broke down seventh day. Phlebitis both lower extremities, wound healed fifty-fifth day and patient discharged.

Case 10.—C. N. 45225, aged twenty, para i. Operation January 23, 1920. Wholly under care of hospital. Spontaneous rupture of membranes four hours before labor. Six vaginal examinations. Condition good before and after labor. Contracted pelvis. Face R. M. T. Living child, weight 3,720 grams. Circumcised by Rabbi, hemorrhage, required transfusion. Mother and child discharged thirteenth day. Primary union, uneventful puerperium. Patient has since been delivered by classical cesarean, successfully for mother and child.

Case 11.—C. N. 45299, aged twenty-seven, para i. Operation February 1, 1920. Only partly under care of hospital. Membranes said to have been ruptured one day before admission. Had had five different private physicians; forceps delivery had been attempted and it was stated that patient had had pneumonia three weeks before admission. Condition poor, operation uneventful, living child, vertex L. A. O., weighing 2,020 grams. Contracted pelvis. Tonic uterine contraction. Mother died second day, lobar pneumonia; pneumococcus recovered from sputum.

Case 12.—C. N. 45579, aged twenty-seven, para i. Operation March 9, 1920. Had been under care of private physician. Duration of labor and management unknown. Patient in fair condition but exhausted. Contracted pelvis tonic contraction of uterus, membranes ruptured. Pituitrin said to have been given. Living child, weight 3,070 grams. Eighteenth day wound healed, mother and child discharged.

Case 13.—C. N. 45664, aged thirty-three, para iv. Operation March 18, 1920. Wholly under care of the hospital, sent from outdoor department. Three vaginal examinations, no attempt at delivery, membranes had ruptured spontaneously 13 hours prior to operation. Condition of mother and fetus fair. The latter lived and weighed at birth 3,400 grams. Both were discharged on the twenty-seventh day. Wound healed.

Case 14.—C. N. 48493, aged twenty-two, para i. Operation March 19, 1921. Labor wholly under care of hospital. Marginal placenta previa. Contracted pelvis, conjugate 9 cm. Condition poor, eclampsia, three convulsions after admission prior to operation. Fetal heart 172. Operation followed by coma. Living child weighed 2,590 grams. Seventy-third day, wound, healed, both discharged well.

Case 15.—C. N. 49789, aged thirty, para v. Operation August 20, 1921. Has one living child, two stillbirths, one child died at four years of scarlet fever. First easy, others instrumental. One internal podalic version, transverse presentation. Wholly under care of hospital, membranes ruptured five hours before delivery. One vaginal examination, condition fair on admission. Delivered living child weighing 3,610 grams. Wassermann for mother positive, child negative. Mother had abscess of right elbow which was incised and drained. Culture from abdominal wound showed staphylococcus albus and from pus of right elbow staphylococcus aureus. Abdominal wound resutured September 19, 1921. Mother and child discharged fifty-fifth day.

Case 16.—C. N. 50207, aged twenty-seven, para ii. Operation October 6, 1921. Wholly under care of hospital, at first in outdoor service. Attempted forceps delivery unsuccessful because of tonic contraction of the uterus. Admitted to indoor department in fair condition. Patient had flat pelvis. Living child delivered weighing 3,710 grams. Cervix was fully dilated, small portion of vertex through brim. There was marked edema of soft parts. Culture from uterus was sterile, that taken later from broken down wound showed staphylococcus albus. Mother and living child discharged in good condition on eighteenth day.

Case 17.—C. N. 51025, aged twenty-eight, para i. Operation January 7, 1922. Wholly under care of hospital, out-patient first. Membranes ruptured spontaneously, had seven vaginal examinations, condition fair on admission, fetal heart 144. Flat pelvis, sharp promontory. No progress or engagement of head after long labor. Delivered living child weighing 3,850 grams, died nineteenth day from pemphigus. Patient discharged forty-third day, wound practically healed. Culture from wound showed staphylococcus albus.

Case 18.—C. N. 51055, aged thirty-eight, para iii. Operation January 11, 1922. Had had one abortion, one living child. Wholly under care of hospital. Patient had funnel pelvis, ineffective labor for days. No engagement of vertex. Positive Wassermann. Condition fair on admission. Living child delivered weighing 3,250 grams. Abdominal wound broke down tenth day, considerable sloughing; vesical fistula. Wound showed staphylococcus aureus. Mother and child discharged thirty-ninth day, wound and fistula completely healed.

Case 19.—C. N. 51501, aged twenty-four, para i. Operation March 5, 1922. Seen in consultation, had been in labor 33 hours, high forceps had been attempted, slight lacerations of the vulva and vagina. Funnel pelvis, no attempt at engagement of vertex. Patient had severe cold prior to labor, subsequently developed lobar pneumonia. Living child delivered weighing 3,650 grams, developed pleurisy with effusion, aspirated twenty-first day. Culture from fluid showed pneumococcus. Patient discharged at own request twenty-seventh day, child living, went home in ambulance.

CASE 20.—C. N. 51651, aged twenty-eight, para i. Operation March 20, 1922. Condition good upon admission, history of active labor 34 hours. Under care private physician, many vaginal examinations had been made. Membranes ruptured spontaneously in first stage. Male type pelvis, vertex R. O. P., no engagement, no molding of fetal head, bones of skull dense. Culture from uterus showed B. Coli. Living child weighing 3,190 grams delivered. Mother and child discharged twenty-sixth day, wound closed.

CASE 21.—C. N. 51653, aged twenty-nine, para iii. Operation March 20, 1922. First child very large craniotomy, second child still living. High forceps had been attempted by outside physicians. Condition fair on admission. Funnel pelvis, large child, no engagement. Living child weighing 5,180 grams delivered. Culture from uterus showed hemolytic streptococcus. A piece of tissue taken from uterine wall shows that it has the structure of a lymphatic gland. There is hyperplasis of lymphoid tissue with marked proliferation of the endothelium lining the sinuses. Mother and child discharged fifty-third day, wound practically healed.

CASE 22.—C. N. 51736, aged forty-one, para vii. Operation March 28, 1922. Patient wholly under care of hospital, first in outdoor service, transferred later to hospital. Had three living children, another child died at one and one-half years from pneumonia, all normal deliveries. High forceps had been attempted, in labor sixteen hours, no engagement of head, flat pelvis, fetal heart rate 148. Fetus weighing 3,800 grams, stillborn. Two cultures from uterus, first sterile, second showed staphylococcus albus, culture from abdominal wound later showed staphylococcus aureus. Patient discharged eighteenth day, wound healed.

CASE 23.—C. N. 54864, aged twenty-three, para iii. Operation February 17, 1923. Patient wholly under care of hospital, first in outdoor service. History of two normal deliveries. One living child, one child lived one hour. Membranes ruptured spontaneously at onset of labor twenty-four hours previously. Eleven vaginal examinations. Condition fair on admission, varying fetal heart from 140 to 180. Had moderately contracted pelvis, large child, no engagement after 24 hours of labor, rigid muscles. Living child delivered weighing 4,425 grams. Culture from wound showed straphylococcus aureus. Mother and child discharged twelfth day, both in good condition, wound healed.

CASE 24.—C. N. 54910, aged twenty-four, para i. Operation February 22, 1923. Patient wholly under care of hospital, membranes ruptured when admitted, condition good. Funnel pelvis, large child, no engagement. Many vaginal examinations, digital dilation of cervix, long labor, no progress. Irregular rapid fetal heart 140 to 180. Passage of meconium. Fetus weighing 4,870 grams, died a few hours after delivery. Autopsy showed atelectasis, asphyxia. Wound broke down; sloughed badly. Culture showed mixed infection. Discharged ninety-third day in good condition.

CASE 25.—C. N. 55760, aged twenty-five, para i. Operation May 27, 1923. Patient seen in consultation, repeated vaginal examinations. High forceps had been attempted by private physicians, membranes said to have ruptured spontaneously at onset of labor. Condition of mother and fetus good on admission. Funnel pelvis, fetal head not moldable. Living child weighing 3,620 grams delivered. Forceps mark over left ear and right malar region. Culture from uterus showed streptococci. Wound broke down, resutured eleventh day. Mother and child discharged thirtieth day, wound healed.

Case 26.—C. N. 56173, aged thirty, para iii. Operation, July 7, 1923. Patient under care of outside physician, reported seven vaginal examinations. Had had two abortions. No full term pregnancy. Said to have been in labor three and one-half days. Condition on admission good. Contracted pelvis, vertex overriding brim, fetus weighing 3,400 grams delivered. Died after six days. Patient discharged thirty-first day, clean shallow granulating wound.

Case 27.—C. N. 56252, aged twenty-nine, para iii. Operation July 14, 1923. Patient wholly under care of hospital. One child living, one died at age of three years. Funnel pelvis, in labor 40 hours, no engagement of head, fourteen vaginal examinations, condition good. Membranes ruptured at time of operation. Living child weighing 3,020 grams delivered. Culture from uterus negative. Mother and child discharged thirty-first day.

Case 28.—C. N. 56351, aged twenty-two, para i. Operation July 23, 1923. Patient wholly under care of hospital. Funnel pelvis. Membranes ruptured two days prior to operation. Ten vaginal examinations. Vertex failed to engage, no progress, evidence of fetal distress, rapid heart, passage of meconium. Living child weighing 2,930 grams delivered. Mother and child discharged twenty-eighth day, wound healed, condition good.

44 Park Avenue.

PAINLESS CHILDBIRTH BY SYNERGISTIC METHODS*

(A Preliminary Report)

BY

JAMES T. GWATHMEY, M.D., ANESTHETIST TO THE HOSPITAL, AND E. P. DONOVAN, M.D., JOHN, O'REGAN, M.D., AND LELAND R. COWAN, M.D., HOUSE SURGEONS

Mythological, profane and sacred literature abound in incident, fact and fancy, showing that from the dawn of history man has sought to assuage grief and pain by some means of dulling consciousness.

Both the Bible and the Talmud contain references to the ancient practice of inducing sleep by artificial means. In these attempts many methods and diverse agents have been employed. The inhalation of fumes from various substances, weird incantations, the external and internal application of drugs and many strange concoctions, pressure upon important nerves and blood vessels, mesmerism, hypnotism, etc., have all played their part in the evolution of anesthesia. But modern anesthesia was not known to the world until after the successful public demonstration of ether by Morton in 1846.[1]

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One of the first uses to which it was put was to modify the pains of childbirth. Sir J. Y. Simpson[2] of Edinburgh, Scotland, was the first to use ether in obstetrical cases, but not entirely satisfied, sought a substitute and to him we are indebted for the second most universally used agent for general anesthesia—chloroform. Common sense prevailed over the opposition of clergy and laity of his day, "to avoid one part of the primeval curse on woman," and chloroform and ether are now used almost universally for special cases and in certain stages of labor. However, where expense is not considered, nitrous oxide and oxygen have supplanted the use of these agents.

In 1880, Klikowitch[3] of St. Petersburg recommended an 80 per cent mixture of oxygen with nitrous oxide for obstetrical purposes and this is about the admixture that is used today for analgesic purposes. Guedel of Indianapolis was one of the first to endorse strongly this combination in normal labor in the United States (1911), and it is now quite generally employed.

Spinal analgesia has been used with success—as have also local analgesics to the cervix, the perineum and the rectum, but these methods have but few followers today.

Schneiderlin, in 1899, recommended the use of morphine and scopolamin for surgical anesthesia, but Steinbüchel first recommended its use in labor in 1902. Krönig and Gauss of Freiburg are responsible for its introduction into the United States, reporting 3000 cases in a paper read in Chicago in 1913. Krönig and Gauss use narcophin, a proprietary narcotin—morphine meconate. There is a good reason for using this combination and those who do not, have no right to condemn or criticise "twilight sleep." Sollman states, (P. 260) "Narcotin has a considerable potentiating action on morphin. The hypodermic injection 5 mg. of morphin produced no measurable analgesic effect with 10 mg. the analgesia was marked in two subjects; the third responded by hyperesthesia. With narcotin 8 mg. was ineffective, 30 to 40 mg. produced first some hyperexcitability then slight analgesia. With a mixture of equal parts of morphin and narcotin containing 3⅓ mg. the analgesia was almost as great as with 10 mg. of morphin alone. This combination was also effective on the subject who resisted morphin." (P. 267) "Morphin probably tends to delay the progress of labor by its psychic sedative action, largely by preventing the reinforcement of labor pains by the contraction of the abdominal muscles."

This system has been in turn, praised and condemned; today it is practically abandoned except by Krönig and Gauss and a few specially equipped sanitaria.

Sollman further states, "the use of scopolamin-morphin anesthesia is justified (if at all) only in specially equipped institutions and not in private practice, or even in ordinary hospitals." It is applicable only in about 30 per cent of labor cases.

All of the above agents and methods require either a specialized technic, unusual equipment or trained personnel. Numerous inquiries from many sources indicate that none of these methods are satisfactory to the majority of physicians.

The development of painless labor by synergistic methods was undertaken from a purely scientific and altruistic viewpoint. It was decided that the method should be so simple that it could be used either in the home or hospital, and by any physician, in an entirely empirical manner. The ideal sought was a state of relaxation and analgesia with consciousness, but little if at all impaired, so that full cooperation might be had at all times. The methods by which this condition was to be obtained were outlined to the chief and attending obstetricians of the Lying-in Hospital, Asa B. Davis and George W. Kosmak, and were as follows:

1st. To start with a minimum dose at which time no definite results were expected and to gradually increase the dose until definite results were obtained.

2nd. To stop at any time in the development of the technic, if either mother or child appeared to be in danger.

3rd. To publish the results whether favorable or unfavorable.

With this understanding, work was commenced on the 10th of February, 1923. The first 4 cases showed practically 75 per cent failure. Today the first chapter of painless labor by synergistic methods is completed when we can secure over 75 per cent success. By "success" is meant the amelioration of pain to such an extent that patients state that they were "helped"—only a few of the 75 per cent had a comparatively painless labor. By "failure" is meant whenever the patient obtained no relief from the method. At no time was the mother's condition imperiled in the slightest degree. Only in one instance did the infant seem to be affected. Whether or not this was from the medication cannot be stated positively, but it seemingly was. In the first series of drugs used, there was not only failure but delay. This delay was in a measure corrected by placing 10 grains of quinine hydrochloride in the mixture. Sollmann states that "satisfactory results have been reported from its use in all stages of labor. This drug stimulates the contractions and increases the tone of the uterus."[4] Since this addition, in only one or two cases has there been any delay, and in these exceptional cases, exhausted nature was more powerful than the drug.

There also seemed at one time to be an increase in the nausea and vomiting. This was corrected in a very great measure by eliminating urethan and paraldehyde, thus also making the final mixture simpler. The other drugs considered fundamental to the scheme are magnesium sulphate, urea, ether and morphine. Two to four drams of the magnesium salts is the maximum dose used in our investigations of painless labor, although the writer has used two ounces of the salts *per rectum* in other cases without deleterious effect. The magnesium sulphate must be chemically pure (the usual commercial product may cost 10 cents per pound—the chemically pure $1.00 per pound.)

Weston and Howard[5] have injected 2 c. c. or more of a 50 per cent solution of magnesium sulphate subcutaneously or intramuscularly more than a thousand times with no local pain or sloughing. They state the sedative action occurs in fifteen to thirty minutes and lasts from five to seven hours, and is found to be a very good substitute for morphin and hyoscin. In a few instances the patient became quiet but did not sleep. In 82.7 per cent it was effective. In 6 per cent the dose was repeated before sedation occurred. In 11 per cent no effect was noted even after three or more doses.

Rector[6] has used magnesium sulphate colonically in doses of two drams in over 300 cases. The Presbyterian Hospital used the salts over 200 times by hypodermoclysis in four dram doses with good results. In both instances other drugs or agents were added to complete the analgesia or anesthesia.

Magnesium sulphate used in two to four dram doses by rectum leaves a margin of safety amply sufficient to satisfy the most critical and is, next to urea, probably the safest drug in the combination. In the final series this drug is given hypodermatically.

In a personal communication, Alma J. Neill, Professor of Physiology, University of Oklahoma, states: "I have found that the rate of diffusion of the magnesium sulphate with urea was rather constant; that is, the range was between 30.9 and 32.1 per cent with the exception of a 6 per cent solution of the magnesium sulphate and a 1 per cent solution of the urea which diffused very much faster, it having diffused 48.1 per cent in the same time. The whole range of percentages was used both with the magnesium sulphate and the urea. Each time the 6 per cent solution of the magnesium sulphate and the 1 per cent solution of the urea diffused practically 50 per cent faster than any other combination or any other substance which I tried."

Hewlatt[7] has given 25 grams of urea every hour until 12 M. (100 grams in all) with no untoward results. Cushney[8] states: "It is rapidly absorbed from the intestine and is practically devoid of action in the tissues even in the larger doses." The amount used, 1 per cent of a 4 ounce mixture, is therefore negligible as far as danger is concerned. It is used with the idea that it increases the absorbability of the magnesium sulphate. The exact relation between "diffusion" and "absorbability" is not definitely known, nor can we state at this time how much the efficiency of the method is due to the urea. Urea is not used in the last series.

"Ether[9] is the anesthetic of choice if the patient is suffering from any form of toxemia or requires stimulation or is suffering from shock." The amount used in our mixture, two to four drams to a maximum of not over three ounces needs no extended comment. (Four to six ounces of ether is the amount used in colonic anesthesia.) Ten years after its introduction for general surgery, oil ether was first systematically used in 100 obstetrical cases by Thaler and Hübel.[10]

The mixture was 90 grams (3 ounces) of ether and 120 grams (4 ounces) of olive oil. The amount used at one injection was 100 c. c. (3½ ounces) introduced very slowly. In a typical case, a few minutes after injection, the eyelids close and a general relaxation sets in. The condition is suggestive of twilight sleep, but if there is no marked effect after ten minutes, a second injection of 50 c. c. (1¾ ounces) is given. In only one case was the method entirely impractical. With this one exception there was no complaint of pain or irritation of intestine.

In 16 cases this injection (50 c. c.) was repeated once.
“ 25 “ “ “ “ “ “ twice.
“ 20 “ “ “ “ “ “ three times.
“ 15 “ “ “ “ “ “ four times.
“ 12 “ “ “ “ “ “ five times.
“ 4 “ “ “ “ “ “ six times.
“ 2 “ “ “ “ “ “ seven times.
“ 1 “ “ “ “ “ “ eight times.

In one case the maximum total amounted to 767 c. c. of which 270 c. c. were lost. No rectal irritation.

In 88 cases the results were satisfactory.

In 4 cases there was absolute failure.

In 80 cases normal or very strong labor contractions.

In 20 cases labor was reduced or retarded. In these cases quinine or pituitary extract was added.

In some cases the labor seemed to be improved by the oil-ether mixture.

In 73 primiparas average duration of birth 20¾ hours.

In 27 multiparas average duration of birth 10¼ hours.

No anomalies of the afterbirth period were observed. No change in fetal heart beat. Usually born pink.

In 84 children condition normal—cried immediately.

In 14 children condition apnoeic—breathed normally in five minutes without resuscitation.

In 2 cases typical asphyxia—1 revived and second—forceps—was not resuscitated.

In the majority of cases during the intervals between labor contractions, the patients lay as if asleep, during labor contractions slightly restless and groaned occasionally.

The time of rectal instillation:

In 24 cases the os was dilated 2-4 fingers.

In 27 cases the os was dilated 3 fingers.

In 9 cases the os was dilated 4 fingers.

In 3 cases the os was dilated more than 4 fingers.

No morphin or alkaloids were used. In no case was there excitement. Vomiting in five cases. Strong thirst in seven cases. After delivery a deep sleep. Upon awakening do not recall any incidents. Of 99 born alive, 1 child died on fifth day, after third day intestinal inflammation and subsequently pneumonia. Some babies were sleepy during the first one or two days. Ether by inhalation in comparison with this method affects the brain too much.

The disadvantage might be the impossibility of exact dosage on account of loss, but according to the writers, the difference of individual reactions makes exact dosage irrelevant. The method is impractical in private homes.

To revert to the synergistic method again the next drug to consider is alcohol. The ounce of alcohol was used principally as a vehicle for the ether; it also increases the absorbability of the mixture. Alcohol is below ether in analgesic qualities. Three-eighths of a grain of morphin *per rectum* (in our opinion) is the limit for this drug. The hyoscin is used to accentuate the value or to synergize the morphin. The alcohol was later reduced to two drams.

"The exaggeration of the effects of small doses of morphin which results from its combination with scopolamin are of great practical importance. This synergism may be experimentally demonstrated in various species of animals, especially in those species in which scopolamin alone, even when given in large amounts, produces no narcotic effects. The combined administration of small doses of morphin and small doses of scopolamin, which by themselves produce hardly any effects, results essentially in an exaggeration of the effects of morphin." (Burgi, Madelung.) Morphin and the hypnotics of the alcohol group when administered simultaneously also act synergistically, with a resulting exaggeration of each other's pharmacological actions. (Burgi, Fuhner.)"[11]

THE METHOD

It is the exceptional patient who is so unfortunate as not to have received instructions, among other things, to keep the lower bowels clean, especially in the last stages of labor. The rule at the Lying-In Hospital is to examine and give a cleansing enema when admitted to the hospital. The patient is then sent to the floor where delivery takes place. The patient is therefore already prepared for the colonic administration of the drugs used, and this is the method adopted. A six ounce mixture seemed preferable, but was too frequently expelled, therefore a four ounce mixture is the final choice.

Time.—In selecting the time for the rectal instillation, we seemed to follow naturally the Freiburg method which is as follows: "After labor is well on its way, when the pains are four or five minutes apart and lasting thirty or more seconds, the first injection (hypodermic) is made." It is at this time that the rectal instillation is given whether in a four ounce mixture or in divided dosage of two ounces. The effect is noticeable about the same time as a hypodermic would be and is not as painful. Analgesia is present in from thirty minutes to one hour after the administration, even in those cases in which a delayed action occurs. The time factor is subject to change.

Suitable Cases.—In the development of this method great care is being taken in rejecting cases that would in any way obscure the issue. For instance, if the uterus is dilating evenly and the contractions occur regularly, but with little pain, no medication is given; and even and sometimes painless delivery is then assured; or, when the cervix is fully dilated (four fingers or more) medication is withheld. Again, if the fetal heart sounds are irregular or bad, or malpositions occur, or if there is any question about the condition of the child, medication is withheld. After starting this method, a patient with indistinct fetal heart sounds was admitted to the hospital. Medication was withheld and the child delivered, but died within forty-eight hours. If the method had been tried in this case it would have properly come under suspicion. The cases selected were those not too far advanced and where there was a possibility of helping them. The selection or rejection of these cases necessarily fell upon the House Surgeons of the Lying-in Hospital to whom full credit is herewith given in exercising unusually good judgment.

Results.—The results have varied, but in the majority of cases, the patients have been "helped," the "pains were lessened" and, in a few, a comparatively painless delivery has occurred. Others were not helped in the slightest, while one or two stated that the pains were "intensified." This last statement can only be accounted for by taking into consideration the mentality of the patient who possibly expected very great help and received but little.

Formulae Used.—After using over fifteen different formulae *the procedure was changed entirely as follows*: The magnesium sulphate is now given by hypodermic and the rest of the medication by rectal instillation. Formula number 16 is 2 c. c. of a twenty-five per cent solution of magnesium sulphate (chemically pure) and morphin is added to the first hypodermic when indicated. Hypodermic is repeated once or twice but without the morphin. The rectal instillation used is:

Quin. Hydrobrom	Grains	10
Alcohol	Drams	2
Ether	Ounces	2½
Olive Oil. q. s	Ounces	4

Reliance is placed upon the synergism of ether and magnesium sulphate for the major effect.

Cowan states that, "in nearly all cases the cervix has dilated with or without the addition of morphin but dilation has progressed faster with the thick tough cervix when morphin has been given with the magnesium sulphate. In excitable patients and where you expect a long labor dissolve ¼ grain of morphine in the first hypodermic of magnesium sulphate. The ether, dissolved in one-third the amount of olive oil is given by rectum but not to the extent as used by Thaler and Hubel. The ether is not repeated as it is retained in over 98 per cent of the cases The following is the usual procedure: Hypodermic magnesium sulphate (chemically pure) 2 c. c. of a 25 per cent solution (with or without morphin) is given when the cervix is dilated about two fingers, and repeated when necessary—one to three times. One to two hours later the instillation is given, when the pains are four to five minutes apart and lasting 30 or more seconds, and when the cervix is dilated two and one-half to three and one-half fingers.

This present technic is far superior to anything we have heretofore used, and with the last forty patients has been changed only in minor details.

Normal cases, not too far advanced, are selected as otherwise the issue would be obscured. The usual method is as follows: Place patient in Sims position and insert small catheter filled with olive oil (to exclude air) three or four inches in rectum. A small glass funnel is attached to free end of catheter and is held just above the hips; the mixture is now poured in slowly. Pressure is made during pains with a crumpled towel held in the hand pressed firmly against the perineum to prevent expulsion.

Cowan improvised a technic for parturient women, for which he cannot be given too much credit, and which is vastly superior to the funnel gravity method just described, inasmuch as it takes less time, is less likely to be expelled and by forcing the mixture into the upper portion of the rectum it is more quickly absorbed. It converts an uncertain procedure into a certainty and is as follows:

Cowan's Technic.—Connect catheter with large syringe holding the mixture, instil slowly, and with gentle pressure force the fluid between pains, the whole amount to be instilled between two and three pains. During pains pressure upon the perineum as heretofore.

This procedure should not take over five minutes, but pressure on the perineum should continue for fifteen minutes more. The advantages of this technic are obvious. The descending head tends to occlude the rectum and make instillation by gravity long and difficult, but with a syringe we can force a considerable part of the fluid beyond the head into the upper portion of the rectum. With this method the whole amount of fluid is retained in over 95 per cent of the cases. Relief of pain is noticed in from fifteen to forty-five minutes, the pain-free period lasting from four to five hours.

Results.—The effect of the synergists upon the nervous system is exciting in 3 per cent of the cases, unchanged in 3 per cent and sedative in 94 per cent.

It was thought this excitement was due to the alcohol, which is now reduced from four to two drams. There has not been a sufficient number of cases since to determine the effect of this reduction.

The deliveries are 4 per cent with forceps and 96 per cent normal.

Occipito-posterior positions rotate in about the same proportion with as without the synergists.

Comparatively, postpartum hemorrhage is unchanged.

Labor is increased in time in 4 per cent, and progresses uneventfully in 96 per cent of the cases.

Nausea occurs in 2 per cent, thirst in 4 per cent, vomiting 8 per cent and normal and uneventful in 86 per cent of the cases.

Pain is increased in 1 per cent, unchanged in 3 per cent and modified or painless in 96 per cent of all cases.

Condition of Baby.—Asphyxia (not fatal) 1 per cent, apnoeic 2 per cent and crying 97 per cent.

CASE REPORTS

From service on Fifth Floor (O'Regan)

With the present technic pain is materially decreased in all cases, and in a few entirely eliminated: and labor is not, as a rule, delayed or prolonged, any more than it would be if the drugs were not used.

From service on the Sixth Floor (Cowan)

July 13, 1923. Mrs. R. W., Multipara. All previous labors normal. When admitted severe pain every two or three minutes and lasting for one minute. Cervix 2 fingers dilated, thick and soft. Ampoule of magnesium sulphate (2 c. c. 25 per cent solution) given at time of instillation. Distinct sedative effect lasting four and one-half hours. Patient stated she felt very little pain but was conscious that contractions were continuing. Second ampoule of magnesium sulphate given but no decided effect. Patient had fairly strong pains for two and one-half hours before delivery. Baby crying when delivered.

Conclusion.—Morphin should have been given with first ampoule of magnesium sulphate, but instillation should have been delayed until cervix was dilated to about three fingers.

July 31, 1923. Para 1, Mrs. I. V. Colored. Moderate sized woman who cooperated well when admitted, was having strong pains every two minutes, lasting fifteen seconds. Cervix three fingers dilated, soft, thin. Hypodermic 2 c. c. magnesium sulphate 25 per cent solution and at same time instillation was given, syringe method. Whole amount retained. Distinct sedative effect. Pains practically subsided, but patient felt contractions continuing. Patient dilated fully with the synergists. No nausea, or vomiting. Patient delivered one and one-half hours after instillation. As head was passing over perineum patient had considerable pain for five minutes. Excited. First degree laceration. No chloroform given except for repair. Baby crying when delivered.

Conclusion.—This patient should have had morphin with first hypodermic and also chloroform during last five minutes of delivery.

July 14, 1923. Mrs. L. S. Para 1. Medium size, pains every five minutes, fairly strong and lasting fifteen to thirty seconds. Cervix three and one-half fingers dilated, soft but not obliterated. Hypodermic and instillation given at same time. Sedative effect lasted three hours and twenty-five minutes when hypodermic was repeated with good synergistic effect. Thirst and vomiting present. Cervix dilated from three and one-half fingers to full dilation. Delivery was spontaneous, four hours and thirty-seven minutes after instillation, and with only one hard pain while head was passing over perineum. No laceration. No chloroform used. Patient drowsy for one hour following delivery. Child crying and normal.

July 22, 1923. Mrs. C. C. Para 1. Moderate size woman, having pains every five minutes and lasting fifteen seconds. One ampoule of magnesium sulphate 2 c. c. 25 per cent solution with $^1/_6$ grain of morphin was given when cervix was dilated two to two and one-half fingers. Instillation given by syringe method when cervix was three fingers dilated, soft, but not obliterated. Whole amount retained. Two and a half hours afterwards hypodermic magnesium sulphate 25 per cent solution. Patient cooperated well. Sedative effect marked, as evidenced by sleep appearance and little pain, but patient stated she felt contractions continuing.

Some nausea and slight vomiting. Cervix dilated fully. L. O. P. position rotated to L. O. A. and was delivered spontaneously about four and a half hours after instillation. Patient had severe pains during last five or ten minutes. First degree laceration.

Conclusion.—A very good result but this patient should have had chloroform the last five or ten minutes while head was passing over perineum.

From service on the Sixth Floor (Cowan)

July 18, 1923, Mrs. V. H., primipara, large, heavy type of patient, having hard pains every minute, very noisy and complaining especially of backache which was almost unbearable. Cervix dilated two fingers. A hypodermic of morphin sulph. gr. $^1/_6$, dissolved in 2 c. c. of a 25 per cent solution of magnesium sulphate, given. The second ampoule of magnesium sulphate without morphin was given one hour later. (Some relief but patient still complains of pain.)

Rectal instillation given one and a half hours after *first* hypodermic, cervix thin and dilated 3 fingers. At first slight irritating effect, sedative effect beginning fifteen minutes after instillation. Backache ceased

(Chart used in evolving this method.)

LYING-IN HOSPITAL
ANALGESIA CHART

A. P. Number.................... Date...................
Formula Number.................
NAME OF PATIENT.................................... Para.................

TIME		
ACTUAL	TOTAL	
		1. Hypodermic { with gr..... without } morphin. Cervix { Dilated....Fingers Thick Soft Hard Obliteration
		2. " effect { unchanged sedative exciting
		3. " repeated { without 4. " " with gr..... without } morphin morphin
		5. Instillation: Retained.... Irritated..... Expelled..... Gravity.... Syringe..... } method
		" Cervix: Dilated....fingers Thick Soft Hard Obliteration
		6. Effect of enema and hypodermic: { unchanged sedative exciting
		7. Contractions of uterus { Not affected increased decreased
		Does labor progress?
		8. Sensation of pain { decreased increased
		9. Delivery— { not affected with forceps without forceps
		10. Do occipito-posterior positions rotate normally?
		11. Condition of baby: { crying apnoeic asphyxia
		12. Postpartum: hemorrhage contraction of uterus
		Remarks on any of above numbers on reverse side.

Directions or Giving Hypodermic and Colonic Instillation.—The hypodermic should be given when the cervix is approximately two fingers dilated. If a 25% solution of magnesium sulphate is used, $^1/_6$ or ¼ grain of morphin may be given with the first hypodermic only; if a 50% solution, give no morphin. The hypodermic should not be repeated unless the sedative effect is wearing off or is insufficient. State object of hypodermic is to *relieve pain.* From now on the patient should be kept as quiet as possible. If in a ward the bed should be screened, if in a room lower shade and exclude light and close the door. Loud talking and noise of all kinds is avoided as far as possible. Just before giving instillation repeat object is to *relieve pain.* When cervix is about three fingers dilated accompanied by good contractions place patient on left side—Sims' position. Fill catheter with olive oil in order to exclude air and insert about four inches into rectum. Place whole amount of instillation in a syringe and give *slowly,* care being taken not to admit air between olive oil in catheter and mixture in syringe. Under gentle pressure pass the fluid *between* contractions giving the whole amount between two to four contractions—tell the patient to "squeeze up" in order to induce reverse peristalsis. State that if contents are retained there will be no pain and thus secure her cooperation. Make pressure on perineum with a towel *during* pains for 10 to 15 minutes, but withdraw tube gently in 5 or 10 minutes. From now on patient can be on back or in whatever position is most comfortable for her. Place cotton in ears and cover head with preferably some dark colored material or with a towel. Give only necessary attention to patient, talking in a low voice and making all manipulations as gently as possible. *Note time of hypodermic and instillation on special chart and fill out chart as labor progresses.*

immediately, pains less severe, but patient was conscious that contractions were still going on. Cervix dilated fully in forty-five minutes and delivery in one hour and forty-five minutes after instillation. Baby crying and normal in every way. No anesthetic used while head was passing over perineum, and delivery was accomplished practically with no pain—no laceration. The analgesic effect was still present after delivery, as evidenced by piercing perineum with towel clip without causing pain. No postpartum hemorrhage.

Conclusion.—Such ideal results cannot be expected in all cases.

COMMENT

It is stated authoritatively "that no drug which can so far abolish sensation as to make labor painless can be given to this degree without affecting considerably the normal process of labor." We cannot entirely concur in this statement, although it seems to be the consensus of opinion of all obstetricians and of all authorities. (As yet magnesium sulphate alone has not been tested for confinement cases.) By using the minimum dose of a number of drugs synergistically, it is believed that the above objections has been overcome. It must be remembered that when the four ounce mixture is placed in the rectum, it is still practically outside of the body.[8] When absorbed into the blood, it is only then a part of the circulatory system.

"In 'twilight sleep,' fetal asphyxia occurs in 9.6 per cent of cases but fetal mortality is not above the average."[9] In our series the percentage is less than 1 per cent and this case was not fatal. The usual objections against twilight sleep (a) prolonged labor for hours and days, use of forceps more often necessary, the percentage of ruptured perineums higher, failure of occipito-posterior positions to rotate normally (b) restless delirium and violence, disturbance of heart and lungs, postpartum hemorrhage and uncertain results, do not seem to obtain with the present method.

In our series only in one case in 64 did asphyxia occur which gives a percentage of 0.64. As a general proposition "synergistic analgesia" is a safer condition than either oil-ether analgesia or "Twilight Sleep." In Twilight Sleep too much dependence is placed upon morphin and its action is too greatly stressed—hence the high percentage of asphyxia. With the synergistic method, we attempt to secure relaxation with the magnesium sulphate as well as using it for its power of prolonging the effect of the morphin. Ether is a powerful stimulant and analgesic as well as anesthetic. The attempt is made here to use it for only its stimulating and analgesic properties and we believe we obtain this by using it in the minimum dosage as given.

SUMMARY

1. Labor is not delayed, for while the pain is relieved the contractions continue in over 98 per cent of the cases.

2. The condition of the baby is not affected by the medication.
3. Ether administered colonically to the mother is safer from the offspring's standpoint than is sufficient morphin to produce the same effect.

CONCLUSIONS

We feel that in this small series of a little over two hundred cases we have established the fundamental principles upon which painless labor may be safely worked out, *i. e.*, by using the minimum dose of a number of drugs, compatible and synergizing, using each drug for a definite and specific purpose.

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40 EAST FORTY-FIRST STREET.

THE TRANSPERITONEAL CERVICAL CESAREAN SECTION[1]

(Suprasymphyseal Caesarean Section)

BY

LOUIS E. PHANEUF, M.D., F.A.C.S.
Associate Professor of Clinical Gynecology, Tufts College Medical School. Gynecologist and Obstetrician, Carney Hospital.
Boston.

THE term transperitoneal cesarean section is a confusing one since, at the present time, it may refer to four different operations, or better, to four modifications of the same operation devised by four different operators, namely Kroenig, Hirst, DeLee and Beck. Although

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they all have in common an incision in the cervix or the lower uterine segment, for the delivery of a child by the abdominal route, they differ somewhat in the disposition of the peritoneal layers after the closure of the uterine incision. DeLee has suggested the term laparotrachelotomy, and although the name is scientifically correct it has not been generally adopted; its use would result in the avoidance of a great deal of confusion. Some continental accoucheurs refer to the operation as the suprasymphyseal cesarean section, while both American and European writers have referred to it as the low cervical and the supra-pubic cesarean section.

Evolution of the Transperitoneal Cesarean Section

Since the early days of cesarean section, the two main troublesome complications have been hemorrhage and sepsis. Porro, of Pavia, in 1876, attempted to overcome these, and succeeded in doing so; but his method entailed the sacrificing of the uterus. In 1882 Saenger, by introducing a proper method of suturing the uterus, so improved the results of the classical operation that the Porro operation was relegated to its proper place, that is a method to be used for special indications in the presence of infection and neoplasms.

The method of uterine suture has passed through many stages, from the using of silver wire, silkworm gut, silk and linen to the present day use of catgut; again, the uterus has been sutured in one layer, two layers, three layers and four layers. Both interrupted and continuous sutures or a combination of them have been advocated. At the present time some writers are reviving the use of silkworm gut and linen as stay sutures in closing the uterine incision, thus tending to show that no method has been entirely satisfactory.

With the introduction of proper methods of suturing, the hemorrhage from the cut edges of the uterine muscle has been largely controlled, so that, in present-day operating this condition is but rarely a troublesome factor.

The prevention of sepsis, however, has not shown such brilliant results and it is for this reason that numerous modifications of the classical operation have been devised for cases where infection was suspected but where one was reluctant to sacrifice the uterus.

The foremost authors in obstetrics are fairly well agreed that in the presence of a virulent infection the best results are obtained by the removal of the infected uterus; the present-day method differs from the Porro operation only inasmuch as the cervix is closed by sutures, covered with peritoneum and dropped back in the abdominal cavity, instead of being fixed to the lower angle of the incision. This means clean healing and a much shorter convalescence. It is further conceded that a virulent infecting organism, the streptococcus for instance, may find its way through the intact peritoneum and cause septic peritonitis even in a true extraperitoneal section.

A large group of cases with unrecognized disproportion between the pelvis and fetal head, come to us after many hours of labor, with ruptured membranes, and having had vaginal examinations in their homes. The disproportion may be such that a pelvic delivery is not feasible except by craniotomy on a living child. Although there may be no definite signs of infection, in the light of present-day knowledge, these cases are considered infected, or at least they are classified as presumably infected. In that type of case the classic operation is contra-indicated because of the danger of peritonitis.

It is a well known fact that each hour of labor, each vaginal examination, and each hour that the membranes have been ruptured has a definite bearing on the morbidity and mortality of the classic cesarean section. It is also well recognized that certain patients having fulfilled all the so-called textbook indications for this operation subsequently develop peritonitis. In the classical type of operation since the incision is made in the body, or contractile part of the uterus, the stitches, no matter how placed, must serve as hemostatic as well as approximating sutures. For this reason they have to be tied rather tightly, and because of this a certain amount of pressure necrosis may result.

Since it has been possible to demonstrate the escape of lochia in the peritoneal cavity between the stitches, it is reasonable to presume that the bacteria which invade the puerperal uterus may find their way into the peritoneal cavity along the same channels, and since the peritoneal cavity is in no way protected from the uterine incision, peritonitis may be the result. This may explain the fact that peritonitis may sometimes develop in the so-called clean case.

The extraperitoneal methods have been largely developed in Europe, notably in Germany, and this because of the fact that so many of the patients coming to the Continental clinics are referred by midwives, the parturients being usually seen late in labor, after repeated vaginal examinations under poor aseptic conditions, and in such state that the classical operation is considered unsafe.

In 1907 Frank, of Cologne, described his operation for neglected cases. This consisted of a transverse abdominal incision, cutting across the recti; the peritoneum was separated from the bladder, and the anterior surface of the uterus, and enough of the lower segment was exposed for the delivery of the child. Later this operation was modified by Latzko, Selheim, and others from the suprasymphyseal extraperitoneal operation into a suprasymphyseal transperitoneal section. The latter differed from the Hirst operation in that transverse instead of longitudinal incisions were made in the abdominal wall, the peritoneum, and the lower uterine segment.

Doederlein attempted to revive the operation of laparo-elytrotomy, which had been first suggested in 1823, and then taken up by Gaillard Thomas in 1871. Here the incision was made obliquely and parallel to Poupart's ligament. The incision offers easy approach to the pelvic connective tissue, and to the lateral portion of the lower uterine segment. After the incision of the lower uterine segment the child is delivered by forceps.

In 1915, Kuestner presented his method, which is a true extraperitoneal section, and reported 112 cases. Later, June, 1922, the same author reports 200 cases with two deaths.

In August, 1918, Markoe and McPherson published their article entitled "Extraperitoneal Cesarean Section in Certain Infected Cases with the Carrel After Treatment." These authors advise the extraperitoneal operation in infected cases and describe their method, which is essentially that of Kuestner. Their results were excellent.

Asa B. Davis, at the Thirty-sixth Annual Meeting of the American Association of Obstetricians, Gynecologists and Abdominal Surgeons, Philadelphia, Pa., September 19-21, 1923 presented a series of 28 extraperitoneal cesarean sections performed on neglected cases. He advocated the approach of the lower segment by an incision parallel to Poupart's ligament. This paper has not yet been published but should appear shortly in the *American Journal of Obstetrics and Gynecology* and in the Transactions of the Association.

The above operations were true extraperitoneal sections, and probably offered the best means of protecting the peritoneal cavity. The disadvantages were that, not infrequently, the bladder and one or the other of the ureters were injured with resulting fistulae; second, the peritoneum was occasionally opened during its separation, thus losing the advantage of the extraperitoneal method; third, the pelvis had to be drained and this resulted in suppuration and long drainage in many instances; fourth, there was more hemorrhage, since the incision in the lower segment had to be made to the side rather than in the median line, and the technical difficulties were greater; and last, the operation could not be repeated because of adhesions.

Kroenig brought a new light on the whole subject when he claimed that the better results obtained by this method were not due to the fact that the uterus was approached in an extraperitoneal manner but because the incision was made in the thin non-contractile lower segment rather than in the thick contractile body of the uterus. His operation consists of opening the abdominal cavity by a low longitudinal incision, separating the bladder from the uterus, making a longitudinal cervical incision, and after the extraction of the child, placenta and membranes, closing the uterine incision and completely covering it with the bladder by suturing the edge of the bladder peritoneum at a level higher than the upper aspect of the incision in the lower uterine segment.

In June, 1920, Barton Cooke Hirst described his technique in his

Atlas of Gynaecology, although he had previously brought his operation to the attention of the profession. He reported 30 operations on "almost certainly infected women" without a mortality. This operation is sometimes referred to as the Veit-Fromme-Hirst operation although in America it is known as the Hirst method.

DeLee, in June, 1919, presented his paper entitled "The Newer Methods of Cesarean Sections; Report of Forty Cases," before the section of obstetrics, gynecology, and abdominal surgery, at the seventieth annual session of the American Medical Association, at Atlantic City. The paper was subsequently published in the *Journal of the American Medical Association.* In this series of 40 cases performed by DeLee and his assistants there was no mortality. This author lays stress on the more comfortable convalescence and the absence of peritoneal shock and ileus. To quote him: "tympany and postoperative shock are decidedly less, and one gets the impression that a woman has suffered only a minor operation not the ordeal of the old cesarean section." His technique is essentially his own modification of the Kroenig operation.

Cornell, in September, 1920, published his article, "The Cervical or Kroenig Cesarean Section," in the *Illinois Medical Journal.* His observations confirmed those of DeLee.

In September, 1921, Beck described the "Two-Flap Low Incision Cesarean Section" and reported 29 cases without mortality. He emphasized the fact that the operation was safe after an efficient test of labor.

In the same year (1921) E. Vogt, of Berlin, published his monograph "The Evolution and Development of the Suprasymphyseal Cesarean Section." This is based on 183 operations performed at the Tuebingen Clinic from 1908 to 1919. The author strongly advocates the cervical cesarean section and believes that it has made the classical operation obsolete. He further believes that the intraperitoneal cervical cesarean section is better than the extraperitoneal, because it is simpler technically, is free from injury to the neighboring structures, takes less time, and is less dangerous to the child when haste is imperative.

Polak and Beck, in May, 1922, illustrate the modified Kroenig cervical cesarean section, in their article: "The Present Status of Obstetrics Referring to the Abuse of Cesarean Section."

In June, 1922, Phaneuf and Hegarty described, in the *Boston Medical and Surgical Journal,* their methods of performing the Hirst and Kroenig cervical cesarean sections, and reported their series of 40 cases. In this series 27 operations had been performed by Phaneuf and 13 by Hegarty. Of the 40 cases reported 33 were according to the Hirst and 7 according to the Kroenig technique.

Munro Kerr, in the *Journal of Obstetrics and Gynecology* of the British Empire, 1922, xxviii, 475, compares the classical to the transperitoneal operation and states that the latter overcomes many of the difficulties of the former. He lays stress on the fact that there is less tendency to subsequent rupture if the incision is placed in the cervix, the noncontractile portion of the uterus.

In July, 1922, DeLee and Cornell in their paper "Low Cervical Cesarean Section (*Loparotrachelotomy*)" report 145 cases with one death, and this in a woman very obese, with toxemia, contracted pelvis, and days in labor. Death was from peritonitis on the fifth day. The authors state that this was a hopelessly neglected case that would have died no matter how delivered. DeLee in the Practical Medicine Series for 1922 reports 11 additional cases, or 156 cases with one death.

In the *Revue Francaise de Gynecologie et d'Obstetrique*, Paris, xviii, No. 2, p. 33, January 25, 1923, P. Gaifami writes on the low transperitoneal cesarean section and extols the advantages of section in the lower uterine segment. He described 50 cases, several with beginning infection. The pregnant uterus was removed in one case 2 years later, and without the microscope no trace could be found of the incision. Conditions in the lower segment are more favorable for healing. In 11 cases the cesarean section was repeated and the cicatrix was firm in all, even when the expectant treatment had been pushed to the extreme.

In December, 1923, Phaneuf reported, in *Surgery Gynecology and Obstetrics*, 80 cervical cesarean sections. This series consisted of 49 Hirst, 26 Kroenig, and 5 Beck operations.

Technique of Operation (Author's Method) Hirst Operation

The abdomen is prepared and the patient is catheterized; she is then etherized and placed in a moderate Trendelenburg position. The operator stands on the left side as in the average pelvic operation; the incision which is median and about 5 inches long, starts at the symphysis and extends toward the umbilicus; the parietal peritoneum is opened in the median line, exposing the bladder and the lower uterine segment (intestines are practically never seen). The uterine peritoneum just above the bladder, where it is loosely attached, is incised to the uterine muscle; the index finger is introduced in the opening and the bladder is gently separated from the uterus; the finger is then directed upward and the peritoneum is separated from one side of the uterus. The procedure is repeated on the opposite side. The visceral peritoneum is then incised in the median line to within an inch of the upper limit of the incision in the parietal peritoneum, and the two layers of peritoneum-parietal and visceral are united by carefully applied interrupted catgut sutures, about eight in number. We prefer the sutures to clamps as they are less likely to tear the peritoneum. The bladder is held under the symphysis by means of a retractor and a longitudinal incision is made in the cervix (an incision large enough to deliver an ordinary-sized child may be made entirely in the cervix, without encroaching on the corpus); the child is usually delivered by the vertex, using the obstetric forceps, if necessary, to assist in the delivery. Great care is used in making the incision in the thin cervix so as to avoid cutting the child's head. The placenta and membranes are extracted, a large strip of gauze is packed in the uterus, 1 cubic centimeter of pituitary extract is injected in the uterine muscle, and 1 cubic centimeter of aseptic ergot in the thigh. The cervical incision is closed with interrupted sutures of No. 2 chromic catgut, and the strip is removed before tying the sutures: the uterus is usually contracting well at this time. After sponging out the uterine incision, the peritoneal layers are further approximated by a continuous suture of No. 0 chromic catgut. As may be seen, the uterine incision is now entirely out of the general peritoneal cavity, and covered almost entirely by the bladder; the conjoined layers of peritoneum are united in the median line by two or three interrupted catgut sutures, and the abdominal wall is closed in layers.

The layers of peritoneum are adherent in the course of a few hours; uterine sepsis usually is apparent at the end of 24 to 48 hours, as shown by the rise of temperature and pulse, at this time, in infected cases. If infected lochia seeps through the uterine incision, it can be drained readily through the cervix, or through the lower end of the abdominal wound without coming in contact with the general peritoneal cavity.

Kroenig Operation

The patient is placed in the Trendelenburg position; the abdominal incision is made as in the Hirst operation; the visceral peritoneum is incised transversely where it is loosely attached just above the bladder, and the bladder is separated from the lower uterine segment; it is now held under the symphysis by a retractor and a longitudinal cervical incision is made within the denuded space; after the delivery of the child, the placenta and membranes are extracted, and the incision is closed with interrupted sutures of No. 2 chromic catgut; the bladder edge is drawn up so as to overlap slightly the upper edge of the transverse incision and then sutured to the uterus, with a continuous stitch of fine catgut, thus completely sealing off the uterine incision. The abdomen is closed in the usual manner.

The incision in the cervix is entirely covered by the bladder, and should infection occur, drainage may be easily established through the cervix or by an anterior vaginal colpotomy.

Beck Operation

This differs from the Kroenig operation only in one respect, and that is in the fact that an upper flap of peritoneum is raised after separating the bladder. After the suture of the cervical incision is completed, the upper flap is brought down and anchored to the uterus by a few interrupted catgut sutures, thus covering over the upper part of the incision; the edge of the bladder peritoneum is then sutured, with a continuous stitch, in such a way that it overlaps the upper flap.

The claim made for this procedure is that it offers a stronger barrier to infection than does the original Kroenig operation. In doing the Beck operation we raise the peritoneum from the lower uterine segment in exactly the same way that we do in the Hirst operation, but we incise it transversely instead of longitudinally thus obtaining a superior and inferior flap instead of two lateral flaps.

In case of infection, drainage takes place through the cervix or the infected area may be reached by means of an anterior colpotomy.

DeLee's second contribution to the operation consists of uniting the fascia over the lower uterine segment by a continuous catgut suture, thus burying the cervical incision under this fascial layer. We have used this method in our last few cases.

Protection Against Infection of the Peritoneal Cavity

There are two points of view on this question: first a number of obstetric surgeons believe that in order to protect the peritoneal cavity, in a presumably infected case, the extraperitoneal route must be strictly adhered to; while others feel that in the presumably infected woman the transperitoneal route offers definite protection. To quote Hirst on the transperitoneal operation: "This method is comparatively simple; and the result has proved (in my experience) that it is reliable, preventing infection of the peritoneal cavity, especially during puerperal convalescence, which is the chief danger of cesarean section upon the presumably infected woman, the infection of the endometrium in such cases spreading directly through the uterine wound to the peritoneal surface and rapidly causing a general septic peritonitis." Newell states that when a woman is frankly infected, no operation which conserves the uterus offers a good chance of preventing peritonitis since even in the extraperitoneal section the bacteria may find their way through the unopened peritoneum. For this reason he advises the removal of the uterus in that type of case. We have not done the transperitoneal operation on a frankly infected case; but in our hands this procedure has given definite protection in the presumably infected woman. Many obstetricians feel that the danger of infection does not come so much from the spilling of the uterine contents at the time of operation as from the passage of lochia and bacteria between the sutures after delivery.

At the present time we resort to the Hirst operation in our doubtful cases, and to the Kroenig or Beck operation in our clean cases.

The Cervical Incision

The cervical incision has a number of points in its favor. The cervix is that part of the uterus which stands infection the best—a fact repeatedly observed in gynecological practice. The pelvis is also more resistant than the upper abdomen; the wound is placed in the non-contractile part of the uterus and may heal undisturbed. The healing of the cervix is better than that of the fundus because active involution and the fatty degeneration of the uterine wall defeat the healing powers of the tissues (Munro Kerr).

This incision is well covered with peritoneum which is adherent in the course of a few hours, so that when bacteria invade the uterus, as they usually do on about the fifth or sixth day, if the uterine incision breaks down a local abscess forms which drains itself through the vagina, or through the lower angle of the abdominal incision, or it may be readily reached through an anterior vaginal colpotomy.

RUPTURE OF THE SCAR IN SUBSEQUENT PREGNANCIES

The incision in the lower uterine segment reduces to a great extent the possibility of rupture of the scar in subsequent pregnancies, because of the fact that the incision heals at rest and undisturbed. In our series there were thirteen secondary operations, one in a woman who had had a septic uterine incision and a utero-abdominal fistula. In none of these cases were there any weak points in the scar and it was almost impossible to distinguish a scar as such. In his 12 cases which came to secondary operation Gaifami found no signs of weakening in any of the scars.

ADHESIONS

Following the Hirst operation, one finds a band of peritoneum extending from the abdominal wall to the cervix. Six of our cases came to secondary operation. We merely divided the peritoneal band between ligatures, separated the baldder and performed the Kroenig section in five of the cases and the Beck in the other. In the seven Kroenig hysterotomies who were subjected to subsequent operations, we found adhesions in only one, this was a third cervical section, one Hirst and one Kroenig having been performed previously. The adhesions here were easily separated, and there was no difficulty in separating the bladder a second or a third time in any of the parturient. As the Kroenig operation is completed, but a short line of suture is exposed, and that is where the peritoneum is attached to the uterine wall; this sinks in the pelvis, and is entirely covered by the bladder as this organ fills.

TEST OF LABOR

The patient may be given an efficient test of labor and this with safety. The result of this is that a number of cases are delivered through the pelvis who might have been delivered abdominally with the absence of this test. It is a well conceded fact that an efficient test of labor adds materially to the morbidity and mortality of the classic operation. DeLee, Cornell, Routh, Holland, and Beck, all agree that an efficient test of labor is safe with the cervical section. Our own experience bears them out. In German clinics the low cervical operation is performed even if the parturient has fever (DeLee).

Hernia in the Abdominal Incision

Hernia has not been encountered in our cases, even the women who developed utero-abdominal fistulae obtained firm scars. It is a known fact that herniae in suprapubic incisions are less common than in the other parts of the abdomen.

Convalescence

The convalescence in cases of the cervical section is practically that of a pelvic delivery. The puerperium is so comfortable following the low cervical operation that one cannot help but be impressed with this advantage. A rare case develops a moderate distention, but we have been impressed with the fact that, in our series, it has always been a soft distension, causing the puerpera no discomfort. The patients are free from ileus, the temperature and pulse remain near the normal line, and no signs of peritoneal shock are observed. If the operation accomplished nothing more than the comfortable convalescence, it would be worth while doing for this reason alone.

TABLE I.—TOTAL NUMBER OF OPERATIONS

	Hirst	Kroenig	Beck	Total
Cases operated upon by the author	48	46	9	103
Cases operated upon by Dr. J. G. Hegarty	10	3	..	13
Total Cases	58	49	9	116

TABLE II.—NUMBER OF PREGNANCIES

	Hirst	Kroenig	Beck
Para-I	42	16	4
Para-II	9	19	2
Para-III	..	9	..
Para-IV	3	2	2
Para-V	1	2	1
Para-VI	1	..	..
Para-VII	1	1	..
Para-VIII	..	..	..
Para-IX	..	..	..
Para-X	1	..	..
Total	58	49	9
Total Cases			116

TABLE III.—LABOR

	Hirst	Kroenig	Beck
Test of labor	41	14	3
No labor	17	35	6
Total	58	49	9
Total Cases			116

Of the 41 Hirst operations who had labor, one had 67 hours, one 36 hours, one 34 hours, two 24 hours, one 20 hours, one 18 hours, and one 17 hours. The others had labor varying from 4 to 15 hours.

Of the 14 Kroenig operations who had labor, the labor varied from 26 to 8 hours.

Of the Beck operations who had labor, one had 72 hours, one 26 hours, and one 12 hours.

TABLE IV.—PELVIC EXAMINATIONS

	Hirst	Kroenig	Beck
Vaginal Examinations	12	3	1
Rectal Examinations	46	46	8
Total	58	49	9
Total Cases			116

The largest number of vaginal examinations on one case was six.

TABLE V.—INDICATIONS

	Hirst	Kroenig	Beck
Cephalopelvic disproportion	36	18	3
Abruptio placentae	3	1	..
Complete placenta praevia	6	1	..
Eclampsia; rigid primiparous cervix	2	3	..
Previous classical cesarean section	4	7	1
High Breech; contracted pelvis	3	1	..
Transverse; right scapulo posterior. Para-V. Four stillborns	1	..	..
Previous Hirst cesarean section	..	5	1
Large dermoid cyst obstructing labor	..	1	..
Soft part dystocia from previous plastic operations and suspensions	..	3	..
Congenital malformation of the vagina obstructing labor	1	..	..
Diabetes. Toxemia of pregnancy	..	..	1
Elderly primipara (40). Rigid cervix	..	..	1
Contracted pelvis	1	5	..
Cephalopelvic disproportion and fibroids	1	..	..
Contracted pelvis; toxemia of pregnancy	..	1	..
Previous Kroenig cesarean section	..	1	1
Valvular heart disease with decompensation	..	..	1
Toxemia of Pregnancy	..	2	..
Total	58	49	9
Total Cases			116

MORBIDITY

Hirst Operation—58 Cases

Seven puerperae had septic uteri with utero-abdominal fistuale, discharging pus freely through the vagina and through the abdominal incision. All wounds were irrigated with Dakin's solution. All the patients recovered. None of the cases developed peritonitis. This group tends to prove that the union of the peritoneal layers in the Hirst operation offers a definite protection against peritonitis.

Case 1. Para-I. Abruptio placentae, packed twice, once in her home, attempts at manual dilation before admission.

Case 2. Para-I. Admitted after 36 hours of labor with a floating head and ruptured membranes. This case was one of extreme sepsis, the whole cervical incision broke down, and one could introduce the sterile fingers through the abdominal opening into the fundus as well as into the cervix. She ran a temperature ranging from 105 to 102, with a pulse of 150 to 130 for 20 days. On the twentieth day her hemoglobin was 30 per cent and she was transfused on this day. She left the hospital on the fifty-second day with a healed incision and in good health. The impressive fact about this case was that while pus was pouring freely from the broken down cervical incision, there was not the least sign of peritoneal irritation, the bowels and bladder functioned normally, and she experienced no abdominal symptoms.

Case 3. Para-I. Right occipitoposterior, floating head, long labor, vaginal examinations outside.

Case 4. Para-I. Right occipitoposterior, floating head, few hours of labor, no engagement, intact membranes, no vaginal examinations. This might have been considered an ideal case for the classic operation.

Case 5. Para-I. Short test of labor, breech left sacroposterior, neurotic woman, no progress, intact membranes, no vaginal examinations. This case might also have been considered in an ideal condition for the classic operation.

Case 6. Para-I. Elderly, in labor a number of hours before admission, no engagement, intact membranes, eczema of the vulva, no vaginal examinations.

Case 7. Para-I. Admitted fully dilated, no engagement, membranes intact, no vaginal examinations.

These seven cases with septic, broken-down cervical incisions were prevented from having general septic peritonitis by the protection offered by the united peritoneal layers. They all recovered and were discharged with healed incisions. One of them, the first case, who was operated upon later by the Kroenig method showed a perfectly healed cervix. Another, case 4, was subsequently delivered in another clinic by a classical section and no weak point was found in the lower segment. Two of the cases fulfilled the indications for the classical operation, that is, just enough labor to dilate their cervices for drainage, intact membranes, never examined vaginally during pregnancy or labor, and yet, we are convinced that they would have died of peritonitis had the latter operation been performed. The last two cases may explain the occasional case of peritonitis, following the classic operation, when we feel that all indications have been fulfilled. Furthermore, it tends to prove that the infecting bacteria were present in their vaginae, since they were never carried in by the examining fingers. The other five cases were considered potentially infected.

Six patients had mild uterine sepsis, with a temperature of 101 degrees, they had no abdominal complications and they all did well.

The following conditions were also responsible for the morbid state; bilateral mammary abscess; broncho-pneumonia; pyelitis; bilateral thrombophlebitis and bilateral acute arthritis of both knee joints (this patient remained in the hospital 2½ months at which time she was discharged well); superficial infection of the abdominal incision occurring in two cases; an abscess between the cervix and the abdominal wall which drained itself through the inferior angle of the abdominal incision on the eighth day; and finally acute dilation of the stomach occurring on the table and necessitating gastric lavage before returning the parturient to her bed.

Kroenig Operation—49 Cases

One patient had pulmonary embolism during the operation, which was followed by pneumonia and recovery: another had a pulmonary embolus the twelfth day after operation; she also recovered. Two puerperae had thrombophlebitis of the left leg; they left the hospital well. Two mothers had acute dilation of the stomach and recovered: another had superficial sepsis of her abdominal incision retarding her complete recovery but a few days.

One gravida was operated upon for ablatio placentae and utero-placental apoplexy. Upon opening the abdomen, the whole anterior uterine wall was found involved in the process. The patient was in such poor condition that a hysterectomy was thought inadvisable. Upon the separation of the bladder, the lower segment was found to be uninvolved, so the Kroenig operation was performed with a satisfactory result.

Beck Operation—9 Cases

There were no complications.

MORTALITY

Hirst Operation

Case 1	Pulmonary embolism
Case 2	Acute gastric dilatation
Case 3	Abruptio placentae and hemorrhage

Case 1. Para-VII, spondylolisthetic pelvis, six stillborn children following forceps extractions, admitted after considerable labor in her

home, no vaginal examinations. She died of pulmonary embolism on the fifth day after delivery. There were no abdominal complications.

Case 2. Para-I, 41 years old, in labor 16 hours. One vaginal examination in her home. Died of acute gastric dilation on the fourth day. The parturient who was about 5 feet in height weighed 250 pounds, she had a sharp promontory, and no engagement after 16 hours of labor. She had had acute dilation of the stomach following an appendectomy a few years previously and her history showed that she had nearly died of this complication.

Case 3. Para-I. Abruptio placentae at term with a severe uterine hemorrhage. She had no dilation and no labor. She died of the results of hemorrhage the day of operation.

Kroenig Operation

Case 1	Broncho-pneumonia: abscess between the bladder and the cervix
Case 2	Eclampsia: moribund
Case 3	Eclampsia: moribund
Case 4	Pulmonary embolism on the 14th day
Case 5	Heart disease; severe myocarditis
Case 6	Pulmonary embolism shortly after the operation, died of pneumonia on the 8th day.

Case 1. Para-II, 28, first labor breech presentation, stillborn, poor physical condition, attack of appendicitis when 7½ months pregnant, and she ran a pulse of 120 during pregnancy. Extensive plastic operations following the first delivery. Test of labor, no dilation of the previously repaired cervix, operation August 23, 1922. She developed an abscess between the bladder and cervix, which was drained by an anterior vaginal colpotomy on September 3, 1922. She subsequently developed a broncho-pneumonia and died. At the time of her death the abdominal incision was healed, and she had had no abdominal symptoms.

Case 2. Para-I, 42 years old, at term, eclampsia, frequent convulsions, no labor, no dilation, moribund when seen. Operation in the interest of the child. The mother died shortly after operation and the child lived.

Case 3. Para-I, 36 years old, at term, eclampsia, frequent convulsions, in deep coma, cyanosed and jaundiced, no labor, two vaginal examinations, 1 ounce of black urine obtained on catheterization. Delivered of a macerated fetus. No urine was obtained after operation and she died 14 hours after delivery.

Case 4. Para III, 30 years old, flat pelvis, 2 stillborns following instrumental deliveries, toxemia of pregnancy, no labor and no vaginals. She was out of bed on the 12th day and was well up to the 14th day when she suddenly died of pulmonary embolism.

Case 5. Para III, 39 years old, 2 previous classical cesarean sections for contracted pelvis, heart disease, myocarditis. She died on the 10th day of myocarditis and had had no symptoms referable to the abdomen.

Case 6. Para II, 30 years old, first delivered by version, large child with the second pregnancy (10 lbs. 8 ozs.), in labor 8 hours, vertex presenting, the head overriding the symphysis, no vaginals. She had a massive pulmonary embolus just as she was returned to her bed, this was followed by a pneumonia and she died on the 8th day.

Beck Operation

There was no mortality following this operation.

SUMMARY

Total mortality 9 cases in 116 or 7.7 per cent.

Pulmonary embolism	3
Acute Gastric Dilatation	1
Abruptio placentae and severe hemorrhage	1
Broncho-pneumonia	1
Eclampsia	2
Heart disease—Myocarditis	1
Total	9 Deaths in 116 cases

There were no deaths from peritonitis.

Total mortality 9 cases in 116, or 7.7 per cent. The mortality in this series cannot be entirely attributed to the operation. Three mothers died of pulmonary embolism one on the fifth day, another on the fourteenth day, and the last as the result of a pneumonia following a massive pulmonary embolus shortly after operation. This condition, while a complication of cesarean section, also occurs as frequently after pelvic deliveries. The two cases of eclampsia, in the writer's opinion, died because of lack of prenatal care; they were both elderly primiparae and when seen in consultation it was too late to hope to save them. The parturient with the premature detachment of the placenta had to be delivered at once because of the hemorrhage, she was at term, she had a long rigid cervix, and no labor. After the extraction of the fetus, the extraction of the placenta and membranes, and the removal of a large quantity of blood clot, the patient went into severe shock. She rallied after the intravenous injection of 1000 cubic centimeters of salt solution, but a few hours later began to fail, and died just as the writer was reaching the hospital to transfuse her. The woman with the heart complication had had three pregnancies close together, she had been delivered by abdominal section because of an absolute indication, the strain of pregnancy on her already damaged heart proved to be too great and she died of myocarditis on the 10th day after a normal surgical convalescence. This leaves two patients (1.7 per cent), one who died of broncho-pneumonia, after having had an abscess drained and, as stated before, without having had any abdominal complications. The pneumonia may have been secondary to the abscess or it may have been the result of the patients' markedly weakened condition. Acute gastric dilation is not usually seen after pelvic deliveries, so in this case the operation may be said to have been the cause of death, and yet, one patient in the Hirst series, and two patients in the series of Kroenig operations recovered from this complication.

TABLE VI.—ANESTHESIA

	Hirst	Kroenig	Beck
Ether anesthesia	58	46	8
Spinal anesthesia	..	3	..
Local anesthesia	..	..	1
Total	58	49	9
Total Cases			116

Spinal anesthesia was administered to three women who had severe upper respiratory tract infections. The operation is well adapted to spinal anesthesia, the only variation in technique being that the patient is not placed in the Trendelenburg position. One Beck operation was done under scopolamine-morphine local anesthesia on a patient with a double valvular lesion and a badly decompensated heart. In this case the abdominal wall as well as the visceral peritoneum were injected before incising them.

TABLE VII.—SECONDARY OPERATIONS

Kroenig operation after the Hirst operation	5
Beck operation after the Hirst operation	1
Kroenig operation repeated	7
Total	13

Five gravidae had Kroenig operations after having had the Hirst operation; one had a Beck after the Hirst operation; and seven had repeated Kroenig operations. Two women had three cervical hysterotomies; the first by the Hirst technique, and the subsequent sections by the Kroenig method. In none of these were we able to identify a scar, as such, in the cervix, and there was no difficulty in separating the bladder in these repeated cases. It is interesting to note that the first case who came to secondary operation was the first one to have three hysterotomies, and was also the first done in the Hirst series—this was a septic case with a utero-abdominal fistula—and yet, at the second operation the incision was found perfectly healed and no weak points were discovered. As far as the cicatrix was concerned the parturient might have had a pelvic delivery with safety had it not been for the fact that she had an absolute indication.

There were two pelvic deliveries following the Hirst section; the first had had her first cesarean after a test of labor for a very large child; she was followed at the clinic during her second pregnancy and instructed to come to the hospital with her first pains; she disregarded these instructions and was admitted when fully dilated and with the head at the level of the ischial spine; she was delivered with forceps. On the eighth day in the puerperium, this patient got out of bed, dressed and walked home, all our attempts to keep her in the hospital were futile. Her cervical scar, in our minds, had been put to a most severe test, and yet, when she was examined at the clinic a month later, nothing abnormal was found. The second case had had a Hirst hysterotomy for a total placenta previa with a severe hemorrhage, at term, and without labor. She delivered herself normally after a labor lasting 4 hours and 45 minutes.

Case No. 31 in the Kroenig series was operated upon for appendicitis two months after her abdominal delivery and no adhesions were found in the pelvis. Case No. 11 in the same series had a hysterectomy a year later for bilateral ovarian cysts, and the scar in the cervix could not be found without the microscope.

TABLE VIII—FETAL MORTALITY

Six children died, four after the Hirst operation and two after the Kroenig section, or a mortality of 5.1 per cent. The causes of death were the following:

Macerated fetus	2
Stillborn	2
Atelectasis	2
Total	6

CONCLUSIONS

1. The transperitoneal cesarean section offers protection against septic peritonitis;
2. There is practically no shock as the intestines are not handled;
3. There is less bleeding;
4. The mother has a much easier puerperium;
5. There is better healing since the incision is in the cervix, the non-contractile part of the uterus;
6. There is less danger of rupture in subsequent pregnancies and labor.
7. An efficient test of labor may be given with safety.
8. We prefer the Hirst operation in doubtful cases, and the Kroenig or Beck operations in clean cases.

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